# WIRED POLITICS:

## Governing transnational electricity systems. The case of Argentina and Brazil.

Ph.D. Thesis

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submitted by

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# Table of Contents

**List of tables**

## List of Acronyms

| Acronym | Original language version | English |
|---|---|---|
| **CAMMESA** | Compañía Administradora del Mercado Mayorista Eléctrico | Argentine Administrator Company of the Wholesale Electricity Market. |
| **ACEA** | Azienda Comunale Energia e Ambiente | Italian multiutility for water, energy and the environment |
| **ASCE** | American Society of Civil Engineers | American Society of Civil Engineers headquartered in Reston, Virginia |
| **CBN** | Radio CBN Brasil | Brazilian Radio Station of the Globo Group |
| **CGE** | Cámara de Gestión de la Crisis de Energía Eléctrica (acronym appears rarely) | Governmental Management Board for the Electric Energy Crisis, Brasilia |
| **CGE** | Centro de Gerenciamento de Emergências | Management Board for Emergencies |
| **CIER** | Comisión de Integración Energética Regional | Regional Commission for Energy Integration |
| **CIGRE** | Consiglio sui Grandi Sistemi Elettrici | Committee on Large Infrastructures |
| **CLICET** | Centro Latinoamericano de Investigaciones Cientiíficas y Técnicas | Latin American Research Center for scientific and technical investigations |
| **DEM** | Democratas | Democratic Party Brazil |
| **DSO** | Distribution System Operator | Distribution System Operator |
| **ECAR** | First Energy's reliability council | First Energy's reliability council |
| **EDELAP** | Empresa Distribuidora La Plata SA | Electricity distribution company headquartered in La Plata |

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|---|---|---|
| **EDENOR** | Empresa Distribuidora y Comercializadora Norte SA | Electricity distribution company headquartered in Buenos Aires |
| **EDESUR** | Empresa Distribuidora Sur SA | Electricity distribution company headquartered in Buenos Aires |
| **EFE** | EFE Agencia de noticias | Spanish News Agency headquartered in Madrid, subsidiary in Buenos Aires |
| **Eletrobrás** | Centrais Elétricas Brasileiras S.A. | Brazilian Electric Utilities Company headquartered in Brasilia |
| **EPE** | Empresa de Pesquisa Energética Brasil | Governmental Energy Research Company |
| **EPEC** | Empresa Provincial de Energia de Córdoba | Provincial Electricity Distributorheadquartered in Córdoba |
| **ETRANS** | ETRANS | Swiss High Voltage Transmission System Coordinator headquartered in Laufenburg |
| **Furnas** | Furnas – Centrais Elétricas SA Eletrobras Furnas | Regional power utility and major subsidiary of Eletrobras, Brasil |
| **GRTN** | Gestore dei Servizi Energetici GSE S.p.A. | Italian Transmission System Operator, headquartered in Rome |
| **Grupo MORENO** | Movimiento por la Recuperación de la Energía Nacional Orientadora | Freelance investigative team around argentine jouralist and writer Rodolpho Walsh interested in the restoration of national energy autarky |
| **HEU** | Hydro-electric utility | Hydro-electric utility |
| **HVDC** | High voltage direct current | Highvoltage direct current |
| **MINPLAN** | Ministro de Planificación Federal, Inversión pública y Servicios. | Ministry of Planning and Public Investment |

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|---|---|---|
| **MISO** | Midwest Independent Operator | Regional Transmission Organization throughout the Midwest United States and Manitoba, Canada. |
| **NERC** | North America Electric Reliability Council | North America Electric Reliability Council Offices in Atlanta and Washinton |
| **NPU** | Nuclear Power Station | Nuclear Power Station |
| **ONS** | Operador Nacional do Sistema Elétrico do Brasil | National System Operator of Brasil headquartered in Brasilia |
| **PJM** | PJM Interconnection LLC | Regional Transmission Organization part of the Eastern Interconnection Grid |
| **PPS** | Partido Popular Socialista | Socialis'ts People Party Brazil |
| **PSDB** | Partido da Social Democracia Brasileira | Social Democracy Party of Brazil |
| **PT** | Partido dos Trabalhadores | Worker's Party Brazil |
| **RTE** | Réseau de transport d'électricité | French Transmission System Operator, headquartered in Paris |
| **RTO** | Regional Transmission Organization | Regional Transmission Organization |
| **SADI** | Sistema Argentino de Interconexión | Argentine Interconnected System in the North now integrated in SIN |
| **SIN** | Sistema Interconectado Nacional | National Grid Brazil operated via the ONS<br><br>National Grid Argentina operated via CAMMESA |
| **SIP** | Sistema de Interconexión Patagónico | Patagonian Interconnected System in the South now integrated in SIN |
| **TEO** | Technical Executive Officer | Technical Executive Officer |

| | | |
|---|---|---|
| **TRANSENER** | Compañía de Transporte de Energía Eléctrica en Alta Tensión SA | Transmission company of extra high voltage electric power headquartered in Buenos Aires |
| **TSO** | Transmission System Operator | Transmission System Operator |
| **UCTE** | Union for the Co-ordination of Transmission of Electricity | Union for the Co-ordination of Transmission of Electricity |
| **UFRJ** | Universidad Federal de Rio de Janeiro | Federal University of Rio de Janeiro |
| **Viasuisse** | Nationale Verkehrs-informationszentrale der Schweiz. | National information center for transport news in Switzerland, headquartered in Biel |

**Summary**

Offering cleaner energy without impacting negatively on the quality of supply, or planning ahead on nuclear phase outs while maintaining beneficial conditions for economic growth all call for significant restructuring in the production, transmission and distribution of electricity. The costs of failing are immense: a failure to adequately redesign electricity systems and associated governance systems could result in large damages to vital areas of political, economic, technical and social life and thus to human development as a whole. At present, energy locks up a substantial part of the policy efforts of the national and international ministerial floors. Especially in the last two or three decades, the topic of energy sustainability has gained prominence in public debates on energy policy.

Since electricity systems are characterized by a multitude of simultaneous and interconnected relations between heterogeneous human and nonhuman elements, the question that needs to be answered from a transnational governance perspective is thus: *how do all the elements that are constitutive to transnational energy systems interrelate with each other and what are the implications of these interrelations for the transnational governance of energy?*

By means of the study of eight major blackout events in the western industrialized world (North America and Europe) and the emerging economies of the South (Argentina, Brazil and Paraguay), as well as by means of an in-depth case study on the planning and construction of the Garabi hydroelectric power plant currently in-the-making between Argentina and Brazil, this thesis aims at making the complexity of transnational energy governance systems visible and to point at the productivity of key concepts from the *sociology of associations* (Latour 1991, 1992, 2005) for understanding their evolution.

My main argument is that technical objects represent the *dark matter* of relations between individual human and nonhuman elements without which social and political systems would not be able to exist and proliferate over space and time (Barry 2001, Latour and Weibel 2004, Latour 2005, Barry 2006, 2010, 2012, 2013, *forthcoming*). In short, I argue that technical objects have an organizing effect on social and political relations, and that therefore their inclusion into theoretical accounts of transnational electricity governance is immensely productive for the generation of innovative and creative solutions in the design of sustainable energy governance systems.

## 1. Introduction

During the last two or three decades, the topic of energy sustainability has gained prominence in public debates on human development (Club of Rome, Rio World Summit, Rio + 20). In these debates on energy sustainability we can find three conceptual angles from which the topic of energy sustainability is addressed: the finiteness of traditionally used fossil fuels, the concern with security of supply, and climate change (MacKay 2008, 5). The problem with all of these conceptual angles is that they are seldom addressed in combination. If we look at the discussion in the media, the debate is split in camps that are predominantly motivated by normative preferences. At the face of declining fossil fuels and their environmental impacts some campaigners advocate a switch to nuclear energy because it is clean (as long as we leave the question of atomic waste out of the picture), cheap and reliable (if we leave the eventuality of nuclear accidents out of the picture). Other campaigners condemn nuclear and fossil energy sources because of their pollution and support wind energy instead, allegedly because of its cleanness. However, these campaigners make their calculus without the wind energy-opponents who reject wind parks because they destroy landscapes or those who reject them because of their intermittency and high costs (in comparison with nuclear or gas, for example) of electricity production. What stays out of the picture, however, is that energy systems are not only a a complex mix of heterogeneous human interests but also of technical elements, discourses and practices in which every single element and its relation to other elements actively participates in the enactment of a particular modus operandi of energy landscapes without one of them being its single cause (Karlsruhe Institute of Technology Energy Center 2013).

In in the maze of analytical reports on all levels of public discussion and political decision-making from the global to the local and the speculations about which development possibilities possess the best chances for successful implementation the question that needs to be answered from a governance perspective is ***how do all these elements interrelate with each other? And what are the implications for the political governance of energy?*** To answer this question I have applied an integrated analytical framework which is capable to map the complex interlinkages of all the elements, motivations and implications of energy-related perspectives in a combined body of knowledge useful for making political decisions that are as wholistic and sustainable as possible. Because there exist multiple policy alternatives when it comes to selecting energy sources that can make our energy supply more sustainable, particular attention hast to be given by

the researcher and the political decision-makers to how the insertion of a new utility in the energy landscape actually changes the overall pattern of interaction in the electricity markets. In this regard, I advance the argument that technical objects are not productively theorized if taken as mere *instrumental facilitators* (Goldthau and Witte 2010) of human made energy transitions (Smil 2010). Instead I understand them as initiators and *mediators* of transformative processes in their own right (Aradau 2010, Marres 2010). I use the *object-oriented approach* inspired by Latour, Latour and Weibel (Latour and Weibel 2004, Latour 2005) and Barry (Barry 2001, 2012, 2013, *forthcoming*) who provides a productive take on the complex questions of contemporary energy governance. Their main argument is that technical artifacts - such as the electricity networks and utilities studied in this thesis - are one of the central organizing principles for contemporary political communities and suggest that therefore any analysis of the re-organization and re-regulation of the electricity sector needs to start from here.

**State of the Art**

While there is a general awareness both in theory and practice that more encompassing and also more multidisciplinary approaches to contemporary energy transitions are needed, very little research in International Relations (IR) has been dedicated to gather further knowledge on how different areas such as planning, financing and operating electricity infrastructure, the management of technological innovation and renewable energy sources, the spurring of economic growth, energy security and integration are intrinsically mediated by technical objects and how this affects the political governance of energy.

Nevertheless, it is in the context of high industrialization and increasing global integration that the importance of technical devices for transnational electricity markets is unparallelled (Barry 2006, 241). Considerable work needs to be done to make measurement and quality assessment comparable between different places (Barry 2006, 240, 241). And this work gains an increasingly dynamic dimension as soon as one acknowledges the fact that it is not dependent on the identity and individual properties of the technical elements or the human actors involved but on the *relations* that exist within the *hybrid collectives* they form (Barry 2006, 242). Technical objects thus become active participants of transnational electricity governance because they convey a piece of information that is not automatically 'visible' to the human decision-makers (such as as electric frequencies, voltages, loads, consumption levels and the like) but that nevertheless impinges on the *direction* of governance options. It is therefore by conveying such information

that technical objects acquire the capacity to change the direction of decision-making processes and contribute to the shaping of transnational electricity governance arrangements (Latour 2005, 46, 71, Barry 2006, 241).

It is common knowledge that technical infrastructure possesses multiple links with interrelated infrastructures and social human landscapes. However, technical infrastructures have the tendency to get trivialized in our contemporary social environments (Marvin and Graham 2001, 19-21). In general, we only notice their profound intertwinement with our lives when delivery fails (Bennett 2005, Graham and Thrift 2007). As soon as this happens, their constitutiveness for all the processes of transformation that take place in society is, however, swiftly unveiled as their speed and direction is immediately altered (Kaika and Swyngedouw 2000, 120). This holds true especially for electricity infrastructures as they are *critical* to the working of virtually every other system such as communication, water, or traffic systems (Marvin and Graham 2001, Van der Leuten 2004, Silvast and Kaplinski 2007a, Aradau 2010, Graham 2010b, Van der Leuten and Lagendijk 2010a).

In the context of transnational electricity governance, the creation of common connection standards is representative of the formation of a "technological zone" (Barry 2006, 240). The construction of converter stations, material transmission infrastructures and the like that become necessary to create common connection standards emphasize the importance of human nonhuman interaction. Specifically, it points at the organizing effect that technical objects unfold in social relations: without them the assimilation and spatiotemporal propagation of systems of production and consumption, as well as of communication would not be possible (Barry 2006, 240; Latour 1991, 1992, MacKenzie 2002). I will draw on the notion of technological zones as coined by Barry and argue that transnational electricity systems are to be understood as "a space in which differences between technical practices, procedures and forms have been reduced or common standards have been established" (2006, 239). This must not necessarily have happened in a political sense yet (normative governance) but in a way that *structured* relations between human and nonhuman elements in a particular field (electric frequency, voltage, other types of infrastructural interconnection) become visible. Technological zones are such that they may be highly diversified in scope, spanning political-administrative units in their entirety and others only in part. They are primarily associated with the deterritorialized space of global capitalism (Amin 2000, 671, cited in Barry 2006: 239).

To a large extent, contemporary analyses of energy transitions and transnational electricity governance in the discipline of IR still rely on anthropocentric and linear perspectives on how to relate existing and future energy resources to future energy policy (Geller, et al. 2004, Bahgat 2006, Goldthau and Witte 2009). I shall argue that their inclusion into theoretical accounts of transnational electricity governance is immensely productive for the generation of innovative and creative solutions in the contemporary energy sustainability debate. Hence, the argument that I advance on the basis of Latour's object-oriented approach (Barry 2001, Latour and Weibel 2004, Latour 2005, Barry 2012, 2013, *forthcoming*) is an innovative one and it is based on the ontological assumption that electricity systems, and by extension energy governance, is made up of *multiple* (not plural)[1] practical and theoretical realities of different human *and* nonhuman actors that are *intertwined* with each other and thereby give electricity systems and energy governance its shape (c.f. also Mol 1999, 2003). Peculiar elements in this assemblage of human and nonhuman actors may be the age, condition and characteristics of existing power utilities and interconnected infrastructures, the peculiar impulse given to the electric system by distinct energy resources such as coal, wind, water or solar radiation, or the financial and economic costs and environmental risks associated with the construction of a particular power utility (Warkentin-Glenn 2006, Boyle 2009, Andersson, et al. 2011). Additionally human patterns of interaction as, for example, the level of household electricity demand in winter versus summer months, the periodic fluctuations in large industrial production or national transport (e.g. school holidays), the general levels of economic activity, and recently the normative desire to opt out of fossil energy sources affect the way in which 'new' energy governance is reflected upon (ibid.). This rather modest enumeration gives a glimpse of some of the elements that are involved in the shaping of the transnational governance of energy and highlights how the political pledge to long-term energy security goes along with a great number of adaptations in different fields of social and political activity and that all need to be strategically planned and coordinated with each other (Barry 2001, Knill 2001). Inappropriate coordination would lead to unnecessarily high investments and also to high risks: investing a majority of financial assets in wind energy without combining it with necessary precautionary measures such as, for example, the concomitant expansion of peak load utilities, or gas or nuclear power plants (Gavronski and Sampaio 2007) might lead to public horror scenarios as turning down heating installations in winter or shutting down economic trading floors in the major financial hubs of the world. More such scenarios are

[1] C.f. Mol (1999, 75-77) discussed in chapter three in this thesis.

possible if we chose to go more in-depth on the critical importance of energy and specifically electricity infrastructure in contemporary world society.

**Empirics**

However, this thesis is not about horror scenarios but considers itself as an explorative analysis and critical contribution to prevent them via the mindful political regulation of electricity systems. The thesis therefore revolves around *my investigation how human and nonhuman actors intertwine in electricity systems and electricity governance*. The two empirical parts of it investigate major blackout events in the western industrialized world (chapter five) and the planning of the hydroelectric power plant of Garabi/Panambi[2] (chapter six). While the analysis of the blackouts allows us to *ex post* observe relational shifts between the human and nonhuman actors involved in an electricity disruption, the observation and analysis of Garabi's ongoing planning phase provides us with a better understanding of the multiple simultaneous transformations in the overall electricity system that become necessary *in medias res* when changes in one point of the electricity network are sketched out. The case study is particularly insightful because the countries of Argentina and Brazil have experienced severe energy shortages around the year 2000 and are since in the process of restructuring their electricity sectors. Despite its peculiarity the analysis of the Garabi power plant under construction between Argentina and Brazil can therefore be regarded as one relevant example of how decision-makers deal with the shifts that are currently going on in Latin America with regard to the establishment of constant and reliable electricity supply.

The analysis of the Garabi planning process is intended to show that national political decision-makers have to deal with highly localized and specialized technological zones (Barry 2006, 241) when they attempt to regulate the transnational electricity governance system politically. It is asserted by Barry (2006, 243) and it shall emerge from the qualitative analysis of the Garabi hydroelectric project presented in chapter six that efforts to create transnational electricity standards can be problematic because of the multiple and simultaneous relationships between human and nonhuman relationships that have to be attended to (Barry 2006, ibid.) If common regulatory norms do not reflect the sociotechnical realities of the spaces to be integrated, they are unlikely to be 'adopted' and hence unfold their disciplinary properties (I draw on Barry 2006, 241). In particular, the analysis illuminates a range of elements and situations that contributed to

[2] The plant is situated on a section of the River Uruguay that is shared by Argentina and Brazil.

the emergence of the Garabi infrastructure projects and interprets their relevance for the development of transnational electricity governance in the region. Among the elements and situations that converged towards the creation of a technological zone around Garabi are the 1990 gas crisis in Argentina, labor market conditions in the engineering sector, the practices of electricity pricing, the motivations of political leaders, the state and condition of existing technical installations and utilities, the mismanagement and reform of the Argentine and Brazilian energy sectors in the 1990's, the genesis of friendly relations between two formerly adversarial countries.[3] The implication of the interrelatedness of these situations with each other for the emergence of transnational governance is such that it results in the necessity to develop specialized technical expertise in order for common regulatory norms to be established (Barry 2006, 241, 243).

**Significance**

Under these circumstances, the originality and the significance of this thesis reside in linking different core challenges of contemporary energy policy: i.e. cooperation between nation-states under conditions of transnationalization in the energy sector, diversification of energy sources from classical to renewable and the interplay between human and honhuman actors. Its results are expected to be of decisive support to decision-makers involved in the sector and to foster a more adequate understanding of the social, political, and economic nature of such electricity systems. By carrying out this case study on Garabi I aimed to investigate and illustrate how agency in transnational energy governance emerges out of the multiple and intricate relationships among human and nonhuman actors and how it is not a characteristic that can be blindly ascribed to any one actor or group of actors – especially not the human ones. Rather, I argue from the point of view according to which agency is dispersed among various heterogeneous actors in an actor-network and in which the precise constellation of power relationships is successively and continuously negotiated among these (Callon 1986, Law 1991, Latour 2005, 29).

Furthermore, the project aims at making a contribution to the embryonic literature on electricity governance in Latin America. While the scholarly literature on energy governance is mushrooming with regard to the highly industrialized regions of the world (McGowan 1996, Midtun 1997, McGowan 1999, Cameron 2005, Griffin and Puffer 2005, Sioshansi and

[3] For an encompassing list of elements and situations that converged towards the emergence of the Garabi project please refer to chapter 6. Summarizing statements can be found in the interim and final conclusions to the chapter.

Pfaffenberger 2006, Kiesling 2008, Glachant and Lévêque 2009), the literature on Latin America is only incipient (Hira 2003, Weintraub 2007, Littlechild 2008, Husar 2010, Maihold and Husar 2010) and often focused on *diplomatic* relations between countries rather than on the technical, social and political specificities of energy cooperation. It thus provides only very restricted insight on the *material* challenges of the region's electricity sector. These challenges are however far from being only instrumental ones (i.e. how can infrastructure be used and how does it have to be maintained/replaced?). Instead they constitute deep relational challenges in the sense that the local actors have to redesign their web of relations among themselves and the existing infrastructure (and its specific peculiarities) at hand. Issues such as the spatial (territory) and temporal (process phases) embeddedness of technical artifacts in social situations, as well as human beliefs and routines are at the center of my investigative effort because it is from the particular way of assembling human and nonhuman actors (such as landscapes and technological tools) that the region's individual technological character will emerge and eventually deploy its influence on the electricity sector.

Conceptually and formally, I shall tackle the discussion of this spatiotemporal reconfiguration with those three conventional approaches to transnational governance that I find most useful with regard to the way they ask questions on how actors that lie beyond the traditional boundaries of the nation-state engage and impact on world politics (Risse 1995). I will introduce International Regime Theory, the International Political Economy of Susan Strange and the Practices Turn in IR in the next chapter. Involving three analytical steps I draw a conceptual boundary from conventional (chapter two) to contemporary approaches to transnational energy governance (chapter three and four). Finally, the theoretical assertions are lent empirical substance in chapters five and six. The conclusion ends the thesis at hand.

I start with the assertion that regime theory made a crucial contribution to IR theorizing with its acknowledgement that multilateral cooperation is needed for the regulation and governance of a range of boundary-crossing issues in global politics. This appraisal is not trivial since previous contributions from IR that are rooted in Realism and geopolitical considerations disregard the possibility of successful cooperation between self-interested nation-states. In a next step, I use Susan Strange's critical contribution to International Political Economy (IPE) to highlight the caveats that we still need to apply with regard to regime theory's suitability for the analysis of transnational energy governance. On the basis of Strange's seminal critique of International

Regime Theory (Strange 1982), I advance six major reasons why Susan Strange's work is better able to contribute to a more fine-grained understanding of transnational electricity governance than International Regime Theory, and praise her endeavor to synthesize relevant insights from realist, liberal and social-constructivist theories of IR in order to provide an overarching conceptual understanding of world politics that reaches beyond these earlier isolated standard paradigms (Strange 1991, 34). In the third section of this chapter, I draw again on the six conceptual categories deducted from Strange's critique of International Regime Theory (Strange 1982) and use them to argue how Practice Scholars in IR have successfully expanded the theoretical scope of governance theorizing by introducing a form of political analysis that is rooted in performative and inter-subjective practices rather than formal social organizations or institutions. Here, I shall consider several reasons why a digression away from authoritative governance in formal institutions and towards everyday situations and activities of policy-making is more appropriate to the analysis of transnational energy governance. Nevertheless, I shall complete the chapter with the conceptual conclusion that none of the three presented IR approaches pays appropriate attention to the role of objects in the constitution of transnational energy governance.

The third chapter discusses the central role of technical objects in organizing and mediating social and technical realities. It introduces the main concepts of the object-driven approach inspired by Latour, Latour and Weibel (Latour and Weibel 2004, Latour 2005) and Barry (Barry 2001, 2012, 2013, *forthcoming*) and puts them into relation with transnational energy governance. Therefore, I introduce another perspective on the transnational governance of electricity, which is informed by new scholarship in the field of New Geography, Critical Infrastructures and the Built Environment. To summarize, I shall argue that the relevance of technical objects from the realm of electricity for transnational energy governance is such that they impinge on the speed and direction that it may take (Latour 2005, 46, 71, Barry 2006, 241). Especially because electricity systems possess interrelations with virtually every other critical infrastructure system they are to be regarded as particularly dynamic systems in which multiple perspectives interact so as to give it its peculiar character (Mol 2003). Users of the interacting infrastructure systems as well as of the electricity system employ several and different aspects to describe what electricity means to them. In order for the electricity system to perform its functions, these *multiple* perspectives have to be taken seriously and integrated into the design of appropriate electricity governance systems. I shall particularly emphasize that *multiplicity* is a

characteristic of the object under study (itself!), that is, the *electricity system*, and that it is irreducible to the properties and identities of the different users of the system (Mol 2003, Barry 2006, 242). The controversies that arise over the political governance of electricity systems among political decision-makers must thus not be taken as associated with different perspectives on one and the *same* object but with the *enactment* of *different objects* (different electricity systems) that are produced as the result of different methods of assemblage (Law 2004, 65). I thus advance a conception that does not postulate the existence of several, potentially distorted, perspectives on the governance of electricity systems. Rather do I suggest that electricity governance is made *in* different relational figurations (Law 2004, 65). Depending on the point of view that one takes on electricity systems different objective governance systems become visible. One and the same system stimulates different objective possibilities for action. In other words, complexity becomes a quality of the object under study and not of the viewpoint that one may take with regard to it. The controversies that take place in transnational governance debates are thus not mere deliberations about the objective essence of the electricity system but conflicts that ask which human and nonhuman elements ought to be included in the governance of electricity systems in order to allow for different situated actualizations. Hence, neither electricity systems nor electricity governance systems may exist by themselves. Rather do they both emerge in the attempt of grasping them and harmonizing the multiple perspectives that exist with regard to it. Transnational electricity governance therefore needs to be understood as *reflexively interwined* with transnational electricity systems. The *becoming* of an electricity *governance* system is therefore intrinsically dependent on the *becoming* of an electricity *system* and vice-versa. Multiplicity, in other words, draws out attention to the *performative* aspects of transnational electricity governance, that is, specifically the multiple directions that its development may take and the uncertainties that go along with such a complex relational conceptualization of change.

In chapter four I elaborate a theoretical synthesis of the expounded arguments. After having presented IR-inspired approaches to transnational energy governance in chapter two and scholarship from New Geography, Critical Infrastructures and the Built Environment in chapter three, I integrate the discussed arguments from the two chapters in a unified theoretical framework that is also suitable for my empirical analysis. The aim of this synthesis chapter is to highlight interfaces and discrepancies between the statements that each body of literature from IR (regime theory, IPE, Practices; chapter two) puts forward and to point at those spots where the literature on critical infrastructures (chapter three) is able to provide a corrective for analytical

lacunae. Most importantly, this synthesis shall support the empirical specification of the research questions that I formulated at the beginning of this introductory chapter for the realities of transnational energy markets and thereby provide an important building bridge from the existing literature on transnational energy governance towards a new theorization of critical electricity infrastructures in transnational energy governance.

Chapter *five* presents first empirical evidence on how technical objects may achieve agency in transnational energy governance. By drawing on a content analysis of eight major blackout events in the western industrialized world (North America and Europe) and the emerging economies of the South (Argentina, Brazil and Paraguay) I formulate preliminary answers on what kinds of heterogeneous groupings of humans and nonhumans play a role in the governance of transnational electricity networks. What becomes visible is that depending on the precise circumstances of action different relational groupings are of relevance. Particularly, different groupings play a role in times of normal functioning vs. disruption of electricity systems. On the basis of these preliminary answers (that are specified in the respective subsections of chapter five) I reformulate the analytical questions posed in chapter four once again and make them fit for application in the field.

The results of the empirical case study on the Garabi power plant are presented in chapter *six*. In this chapter I argue that the governance of the Garabi power plant cannot be understood as an anthropocentric and linear transition from fossil fuels to renewables but that instead multiple human and nonhuman actors actually converged to re-configure relations and realities to make the execution of the project possible. I will make this decentralized and distributed nature of decision-making between humans and things visible by presenting my insights in the form of vignettes.[4]

In the concluding chapter of the thesis I reflect on how the elaborated theoretical perspective worked out in my empirical analyses and argue that the sociology of associations provides a good entry point for studying the emergence of new transnational energy governance systems from a more object-oriented perspective. Specifically, I shall state the case that studying transnational electricity and infrastructure governance from a traditional IR perspective, that is, under the application of the traditional units of analysis and theoretical models of decision-making, no longer bears resemblance to what is actually happening in the empirical field of transnational

[4] c.f. chapter 6, subsection on empirical results.

energy governance. The main conclusion is that conceptualizing agency in transnational energy governance following the logic of *performative emergence in hybrid human nonhuman collectives* can provide promising ideas with regard to the explanation of the pace and direction of transnational governance arrangements in energy than if we follow a political logic of intentionality.

## 2. Transnational governance of electricity

In the field of IR transnational governance has developed as that branch of study that deals with questions of interpenetration between the state and non-state actors across territorial-administrative boundaries more broadly. A vast body of literature exists that discusses the emergence of 'governance' as a conceptual means to theorize authoritative rule-making beyond the state (Rosenau and Czempiel 1992, The Commission on Global Governance 1995, Murphy 2000, Weiss 2000, Knill and Lehmkuhl 2002, Eberlein and Newman 2008, Héritier and Lehmkuhl 2008). I will not engage with all of these approaches directly but select those that I find have the most to contribute for an analysis of transnational energy governance. Covering that discussion extensively would signify to map out the plethora of ways in which the term of governance is used across the different sub disciplines of political science and beyond - which would go beyond the scope of my thesis[5]. I shall therefore introduce International Regime Theory, the International Political Economy of Susan Strange and Practice Theory in IR as those three approaches to transnational governance that I find most useful with regard to the way they ask questions on the multiple ways in which actors that lie beyond the traditional boundaries of the nation-state "engage in and impact on" world politics (Risse 1995).

### International Regime Theory

Within the disciplinary boundaries of IR, the study of transnational governance is rooted within the earlier identification of interdependence as a characteristic feature of interstate relations (Keohane and Nye 1977) and within the concomitant concern of stabilizing cooperation among states with the help of international regimes. The seminal works by Keohane and Nye (1977), Keohane (1984, 1989), and Krasner (1983), which we nowadays identify as the bedrock of the international regime literature, constitute the first attempts to engage in the political discussion of transnational space. They acknowledge that most issues affecting political communities are inextricably transnational in character and suggest that international regimes should be created to help manage or regulate those issues more efficiently (Krasner 1983, Keohane 1984). These early contributions have to be read as an innovative critical response to the previously dominant realist literature in the discipline of IR, where scholars do not recognize the possibility of successful state cooperation under the umbrella of international regimes (Morgenthau 1948, Waltz 1979).

[5] Sound synopses of the state-of-the-art in the field have been given e.g. by McGrew and Held (2002) or Wilkinson (2005).

The sudden acknowledgement that "interactions across state boundaries [with] at least one non-state actor involved" take place on a regular basis in world politics (Keohane and Nye 1971, xii-xvi) must thus be considered as an important turning point in the history of the discipline of IR. It represents the analytical start for a more differentiated study of the political, the social, and the technical intricacies of energy and electricity networks.

Indeed, the definition of what is political, social and technical and what is distinctive of every one of those realms is something that has worried political scientists and IR scholars on a regular basis[6]. Conventional IR approaches as International Regime Theory frequently theorize the social as a bloc – often termed *society* or *class* or *network* - that can be "grasped and managed as a whole" by both researchers and political decision-makers (Barry 2001, 16). The political is then understood to be the set of processes, structures and target-oriented 'policies' that are put in place to govern *over* the so-defined social. This extrinsic understanding of the social and the political is especially powerful in International Regime Theory where state-society interactions play only a very limited role when it comes to understanding the formation and maintenance of a regime.[7]

In this context of multilateral regulation of transboundary issues by a priori defined collective political actors, regime approaches relegate social conditions as well as technical devices to the very background of transnational governance. And, especially with regard to the latter, i.e. the technical, the 'back-staging' of technical artifacts or 'têchne' (Deleuze 1989, Foucault 1995) is particularly flagrant than that of the social. In this theoretical perspective technical artifacts are merely pictured as *instruments* in conflicts between human actors (Barry 2001, 9). As instruments they may be facilitators of human agency or external constraints to it (Buzan, et al. 1998) but not autonomous structuring elements of the relation between humans. In other words, they may certainly not be actors in their own right with regard to the issues of transnational governance (Latour and Weibel 2004, Latour 2005, Braun and Whatmore 2009).

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[6] In what follows I will make more explicit what I understand under the social, the technical and the political. However, to define them briefly here I would like to state that *the social* is understood as a grouping of heterogeneous elements that are, however, not in themselves social. The social is therefore not to be used to a priori define a stabilized state of affairs but instead it should be thoroughly scrutinized what kind of ties exist between the mentioned heterogeneous elements (Latour 2005). *The political* is then understood as what emerges when social relations and states of affairs touch upon the responsibility of government, that is, require the need for state regulation (Barry 2001). Lastly, *the technical* is here understood as the sum of social, political and specialized technical relations and elements and not merely as a self-contained and inanimate thing (Barry 2001).

[7] This extrinsic understanding is also reflected in the semantic differentiations of 'politics' (process dimension), 'polity' (form/structure) and 'policy' (contents) that are basic knowledge to every first-year student of political science (Patzelt 2001, 29-30) and that I oppose to the larger notion of the political (Barry 1999).

**Interim conclusion**

To summarize, regime approaches focus their attention on the processes of emergence and impact creation of international regimes among *nation-states* while the social and the technical are treated as being *exogenous* to these processes (Ruggie 1972, 1975, Krasner 1976, 1983, Keohane 1984, Haggard and Simmons 1987, Keohane 1989). The social and the technical are the issues on which state regulation is imposed from the outside or on which the state can *act upon*. By contrast, my own use of the concepts of the political, the social and the technical in this thesis differs starkly form International Regime Theory. Indeed, it shall bear resemblance to the more integrated perspective suggested by Barry (2001). In his definition of the three concepts Barry foregrounds the *intrinsic* bond that exists between them and that makes them mutually and simultaneously constitutive for each other (2001, 9). In this conception, the technical, the social and the political are not subsequent steps in a *hierarchy* of political decision-making but they are mutually constitutive and the very *fabric* out of which the same political decision-making is made. What I find useful nevertheless in International Regime Theory is the ground-breaking acknowledgement of the difference between 'territoriality' vs. territory, i.e. the awareness that issues that are of political concern to civic communities may cut across different administrative territories thus automatically relating to more than one civic community at a time. The insight that problem solving with regard to such transterritorial issues must take place in a multilateral framework to ensure appropriate handling of mutual concerns constitutes an important cornerstone in discussions of transnational governance and is consequential for my discussion of transnational electricity governance.

**International Political Economy**

Grounded in the critique of the limitations of International Regime Theory, IPE scholars developed more differentiated approaches towards the governance of transnational space. They exposed further entanglements between the state and other collective entities that, in turn, spurred a range of further critical contributions on how state authority was changing in relation to the emergence of market authorities (Strange 1996, Cutler 1997, 1999, Cutler, et al. 1999, Ronit and Schneider 2001). With regard to the present literature review, which directs its attention to existing approaches of transnational governance suitable for the analysis of transnational electricity networks and their change, the contributions by Susan Strange seem the most valuable

for six reasons.[8] These are (1) the opening of the blackbox of the state as a unitary actor; (2) the theorization of the intrinsic relationship between politics and society; (3) her criticism of rationality assumptions; (4) her accentuation of the relevance of the empirical case for theory-building; (5) the re-conceptualization of the notions of stability and change in IR and (6) the importance of technology for stability and change in IR. I deduct the major arguments for these six points from her seminal article against International Regime Theory (Strange 1982) and supplement them with statements from other critical contributions of hers. For easier legibility, I shall number each paragraph according to the reason it discusses.

(1) The first reason is her critique of International Regime Theory's foregrounding of individual nation-states as the sole agential entities in transnational governance. By asking how a regime emerges between states and how it influences state behavior, she argues, the dynamics of *state-society interactions* are systematically overlooked (Strange 1982, 496). She considers this confinement to state-actors as the central actors in transnational governance as problematic in two ways. First, it fails to capture the state-societal negotiations and bargains that eventually lead to the states' participation in and compliance with an international regime (Strange 1982, 496).[9] Second, an exclusive focus on international regimes leaves those transnational issues unattended where no regimes exist. Such issues may be found in those areas of transnational governance where states either have no common agreement (Strange 1982, 491) or where the regulation of transboundary disturbances have not yet touched upon the responsibilities of governments (Barry 2001, 5). From today's perspective, it is a truism to state that entities other than nation-states and their government apparatuses engage in and impact on global politics. But to retort how is a inquiry left untackeled by early contributions of regime analysis. This is where Strange's work comes in (c.f. in particular Strange 1994a). Strange was one of the first IR scholars to go beyond the "common sense of IPE orthodoxy" and to include also other entities into her analysis of global politics (1991, 34). Her desire to synthesize relevant insights from realism, liberalism and constructivism so that an overarching conceptual understanding could develop between these earlier isolated standard paradigms (Strange 1991, 34) brought her to question the sole authority of the state and to develop an alternative understanding of global politics that could explain global political agendas beyond the limited interests and preferences of nation-states. For Strange

[8] From a textbook perspective Susan Strange has come to be identified with International Political Economy, however she would have been reluctant herself to classify her work under this heading (Tooze and May 2002, 2).

[9] Axiomatic contributions that consider state-societal bargains and their implications for international decision-making are e.g. Putnam (1988) or Moravcsik (1997).

this alternative understanding of global politics is deeply rooted in the tight interplay between the state, the market and technology, which together produce several global power structures that in combination only represent global politics (1994a). The insight that the authority of the state is substantially dependent on other sources of agency in the international political economy is thus of importance here.

(2) The second reason why Susan Strange's work is relevant for the present thesis is her social-constructivist argument that states are not only in competition with other actors (e.g. the market or technology) but that they are also constitutively affected by them. While the existing contributions from IR, Economics and Law[10] reproduce an understanding of politics as something that is superimposed and thus external to society (Tooze and May 2002, 3). Strange aims to transcend the divide between the social and the political in IR and suggests a view in which global politics is constituted in the interplay of both state and society. The state is not the sole source of authority in global politics but is in competition with powerful corporations and that are also capable of establishing legitimate authority in areas such as global security, production, finance, knowledge etc. (Strange 1994a). In this setting, her key analytical concern is thus to study which actors achieve power, why and how this power is exercised in international relations.[11] In her quest to digress from the concept of resource-based absolute power advanced by realist scholars (Morgenthau 1948, Waltz 1979), and driven by a similar motivation as Krasner when he formulated his concept of meta-power (1981, 122),[12] or Nye when he formulated his concepts of hard and soft power (1990) Strange conceived structural power as a counterpart of classic relational power. Whereas relational power is understood as the power to directly "affect *outcomes* such that [a person or group's] power takes preference over the preference of others" (Strange 1996, 17) the concept of structural power relates to indirect power in terms of the capacity to *structure* and control a contextual *environment* (Strange 1996, 26) and determine "patterns of power" (Strange 1996, 16ff) that make up the global political economy.[13] To reflect her intent of relativizing the weight of static power allocation in global politics rhetorically Strange coined the term of 'structural power' (Strange 1996, 25). It caters to a

[10] For elaborations on International Law from an IPE perspective see e.g. Cutler 2003.

[11] I shall criticize this actor-centered conceptualization of power later.

[12] I am only drawing on the similarity of *motivations* for theory building here since Strange has criticized Krasner elsewhere (1994).

[13] Strange defines four primary power structures in the global economy and four secondary power structures that are assumed to rely on the activities that take place in the primary power structures. The four primary structures are security, production structure, financial and knowledge. The secondary structures are transport systems, trade, energy and technology and welfare (Strange 1994).

relevant point of how relational environments 'inanimately' affect political decision-making in interstate relations. However, Strange remains captive of the antagonistic duality of active human agents versus passive natural environments. Evidence can be found in *The Retreat of the State* where Strange explicitly states that she regards power structures as 'contexts' within which relations of variegated kinds develop: "Male partners may not wish or intend the control they have over outcomes affecting their female partners. But as many women are acutely aware, the social structures within which the partnership exists will make sure that such power exists" (Strange 1996, 27). Even if she acknowledges the importance of social and technical dimensions for the constitution of agency in the political sphere, Strange is thus nevertheless asserting that both are external to it and mainly function as the *context* in which agency *takes place*.

(3) The third reason why Susan Strange's work is valuable for my own theoretization of transnational energy governance is her 'deep suspicion' of 'rational choice models' and of 'grand theory' (Tooze and May 2002, 2). While some of the literature on international regimes relies on the assumption of rationality of human actors to explain the constitution of world politics, Strange acknowledges the fluidity of human value systems and consequently the highly probable variability of long-term relationships (agreements etc.) among these. This boundedness of human will and specifically the potential interference of *instinct* that Strange alleges (1996, 20) thwarts any assumption of rationality for political decision making (1976a, 1976b). Similar to more contemporary approaches to global politics, her argument is prompted by the observation that intentions always collide "with other beings, forces, or institutions" (c.f. also Bennett 2005, 453) and suggests that rational choice theory gives an idealized vision of political actor's purposefulness in a decision-making process. She proposes to abandon the view that means and ends are always perfectly matched in a decision-making process and to acknowledge that decisions and ensuing measures are constructed in specific historical and political circumstances. Her call for the discipline of IR is that this *dependent* character of decision-making should be appropriately *reflected* and not *simplified* in theoretical modeling. Strange makes the relevant point that 'grand theory' - through its overtly static and formalistic theorizing - disregards the structural constraints on agency in a world in which agency is *constructed* in the *interaction* between agents and structures (1991, 4).

(4) The fourth argument why Strange's work makes an important contribution to the study of transnational electricity networks in this thesis turns on the need to accord more relevance to the

specific peculiarities of the respective cases under study as a means of *laying bare* the complexities of real-world policy-making (c.f. previous paragraph). Transnational governance is not only subject to the will of one or more individuals but is altered and permuted by the interaction with other individuals and collectives (Strange 1996, 20). To find out how they are changed Strange suggests us to look at the real-world social and political conditions that prevail at the time of analysis. The contingent dynamics of interacting subsystems play a major role in processes of political/infrastructural decision-making. Generalizations, Strange states, can thus only be made with a particular case in mind and thus for a peculiar field of action. As Tooze and May state "[Strange's] notions of structural power are not abstract theoretical generalizations but concepts *made concrete* and *given meaning* by contact with historical situations, which *could and would change* if the concrete world itself changed" (2002, 15 emphases added).

(5) Fifthly, by looking more attentively at the peculiarities of specific case studies we can observe how much *effort* is actually put into achieving a *durable* agreement over issues of contention between states. In traditional regime theory (canonical: Krasner 1983) stability is often emphasized over change (Strange 1982, 488). The argument is that institutions are dull and that their standards and regulations sustainably constrain actors to abide by their routinized activities. Via all the above mentioned points Strange directs our attention to the misunderstanding that underlies such a diagnosis of stability in international politics and stresses the necessary distinction that has to be made between static "Articles of Agreements" (1982, 489) and essentially fluid relationships between (state) powers (1982, ibid). She cites examples from international security, monetary relations and trade to highlight how articles of agreement are often irrelevant as they seldom actually *guide* the behavior of states. Rather do they *rest* on the participating states' behavior (e.g. security).[14] Drawing on other examples from monetary and trade issues Strange observes furthermore how principles and rules are alternatively influenced by long phases of stagnation on the one hand (when states cannot agree on the terms of the agreement; e.g. monetary relations), and by phases of substantial adaptation to the rapidly changing conditions of world markets on the other hand (e.g. monetary relations and trade) (1982, ibid). Eventually, sectoral policies develop as a sort of 'palimpsest' (Genette 2000), that is, out of *former* decisions and non-decisions, out of changes and stagnation in relational settings (Strange 1994a, 231). Though I do not regard it as sufficently articulated yet, I recommend to

[14] C.f. Downs et al (1996) for a related argument on how the establishment of a treaty is endogenous to the interests of states and their will to comply.

credit Strange's understanding of world politics as something fragmentary and non-linear that she professes with her call to lay bare the *particular* entities that participate in the constitution of world politics versus finding generalized explanations for this field of study. Strange in fact suggests to start political analysis bottom-up on a "sectoral level" with a matrix listing the four primary power structures (horizontal axis) and the components of the authority-market relationships (vertical axis) in order to determine all the components and specifically the changes that together contribute to the forming of transnational governance in a particular sector (1994a, 323).[15] Her concern with "assembling some kind of kit" that enables the researcher to contingently trace the *actual* changes that took place in a specific spatiotemporal setting represents a relevant starting point to achieve a more fine-grained analysis of how agency is actually constituted in international relations. In this sense, I take Strange's concern with the analytical matrix (1994a, 323) as a welcome act of caution vis-à-vis the general custom of some IR traditions to indiscriminately attribute agency to international organizations and other groupings independently from a prior analysis of which sub-entities are actually involved in the empirical case under analysis. Also, it has already been criticized elsewhere that "even though the media flood us with new information every day, analysts usually fall back on the same set of century-old theories to explain what has happened" (Murphy and Tooze 1991, 11). I suggest that Strange's concern with the peculiarities of case studies can be interpreted as a response to such criticism: the acknowledgement of the tiny adjustments and everyday efforts that are necessary for the achievement of agreements and even more so for their maintenance by a wide range of involved actors. In other words, she uncovers the necessary process wisdom that articles of agreement are always one step behind the behavior of involved actors and the reality of political relationships if they are interpreted on their own without taking into account the practices of participating states. This is a crucial indication as researchers must be careful not to equate the immutability of formalized agreements with actual stability in global politics.

(6) *Lastly*, and of particular 'topical' importance to the argument I want to make myself is reason number six. It turns on the importance of technology in global politics (Strange 1991, 1994a).[16] With regard to information technology, Susan Strange defines technology as "a more dynamic force for structural change than either the actions of states in the international political

[15] In a way, Strange's matrix is remotely similar to Latours "list of controversies" as it also aims at determining the key elements of political change (2005, 31; making a list of controversies).

[16] C.f. also Talalay (1997)and Porter (Porter 2002) for an IPE conceptualization of technology in world politics.

system or the condition of markets" (1991, 38). She argues that the evolution of communication systems has outpaced the government's control possibilities and redistributed bargaining power "in favor of the rich and powerful at the expense of the poor and the weak" (Strange 1991, 38). Particularly *innovation* in technology, she states, is highly likely to alter the perception of costs and benefits and thus the interests of national administrations and other players. What this reordering of power hierarchies between states means for the future of transnational governance is exemplified in the following quote:

> "New technology in chemicals, liquid natural gas, nuclear power, and oil production from under the sea – to mention only a few well-known areas – is dramatically increasing the risks involved in production, trade and use. These risks become (more or less) acceptable thanks to the possibility of insuring against them. But though this has political consequences—imposing the cost of insurance as a kind of entrance tax on participation in the world market economy—the fact that no structure or process exists for resolving the conflicts of interest that ensue is an inadequately appreciated new aspect of the international system" (Strange 1982, 490).

In consideration of Strange's predominant analytical question of who has power in the international system, why and how it is played out, the point which I want to emphasize here that Strange picks up the topic of the *distributive* power of technology in the sense that it grants power to those actors (states or corporations or else) who are capable of translating it to a competitive advantage and implement it in the world market (Strange 1982, 490). In *States and Markets* she illustrates the inauspicious case of Italy, which "though leading in technology and wealth in the fifteenth century […] found itself handicapped by two tremendous disadvantages: political disunity and *a lack of coal*" (Strange 1994a, 191; emphasis added).

**Interim conclusion**

It was not my intention to give an encompassing overview about what the entire literature on the International Political Economy has had to say on the transnational governance of electricity. Neither was it my aim to provide an encompassing exegesis of Susan Strange's work in general. Rather was the reference to the work of Susan Strange specifically chosen to highlight those major arguments stemming from IR that can illuminate that area of transnational electricity governance that is under investigation here. To recapitulate, the importance of the aforementioned arguments made by Susan Strange for the present thesis are as follows:

(1) Although writers on international regimes readily acknowledged the existence of interdependencies between state-state relations (Keohane and Nye 1977, Krasner 1983, Keohane 1984) Susan Strange has contributed significantly to the appreciation that the confinement of international political analysis to merely *state actors* is overly reductive (1982, 491). She directed our attention to the fact that such confinement does not address the state-society bargains that underlie international agreements among states and also pointed at its inadequacy for providing explanations for those cases of transnational problems where states do either not agree on joint action or where such a problem does not even appear on the political agenda of nation-states. For the present thesis' theorization of transnational electricity governance I want to credit her judgement that *agency and power* are not an exclusive characteristic of *unitary states* but are *distributed* within and across the territorial-administrative boundaries of this historical entity. However, the strength of Strange's argument is strongly limited by the ontological assumptions she makes, that is, especially by her conceptualization of the state, the markets and technology as three distinct and mutually exclusive entities in the international political system (1991, 38-39). Therefore, I shall draw on an alternative approach to deconstruct these traditional units of analysis of IR further in the next chapter.

(2) In explaining what it means to conceive agency as distributed between different actors from the state and from society, Strange relies on a *social-constructivist* argument (Giddens 1984, Wendt 1987). She posits that there exists a joint construction of global politics by actors and structures. Actors and structures are in a co-constitutive relationship with regard to the creation of social and global political structures (Strange 1994a, 1996, 27). What is consequential here – at least vis-à-vis classical International Regime Theory - is her acknowledgement that the state is

not the *sole* but merely a *particular* source of authority within the realm of transnational governance (Strange 1994a).

(3) A further important point is Strange's remark that rational choice theory provides an idealized vision of a human actor's *purposefulness*. In her argument Strange acknowledges the relational component of transnational governance by conceding that agency is not a natural characteristic of any one entity but instead is *developed and formed* in the encounter of individual value systems and "structural" settings (1976a, 1976b). The capacity of human actors to match means with desired ends in a linear and cumulative way is thus automatically thwarted because of the continuous in-flow of additional information. Put concisely, Strange's argument is that political decision-making in transnational settings is contingent on 'fluid' factors such as individual value systems and historical and political constellations that may not necessarily be identified in advance but are continuously evolving. In what follows, I want to build on this argument of intrinsic *uncertainty* while at the same time advancing my reservation on Strange's understanding of *who* contributes to the alteration of historical and political constellations: Rather than regarding the rational development of political decision-making as jeopardized by the 'erratic' nature of the human mind only (1996, 21) I will argue that the uncertainty involved in political decision-making processes is due to the complexity of interactions taking place between humans *and* things. I therefore regard inanimate objects not only as an *external* hindrance of human action but as an *endogenous* hindrance to the *very possibility* of a human conceiving a specific kind of action.

(4) In the same intent of covering real-world complexity, I also decide to pay special attention to the uncertainty argument put forth by Strange. Her acknowledgement that transnational governance is to be investigated in the actual small-scale interplays that exist between actors so as to shed light on iterative long-term *transitions* as well as the *abrupt* policy *changes* that characterize electricity governance is consequential: if transnational energy governance is formed and shaped in the discursive *encounter* among various actors including different social and political backgrounds and if it is granted that these actors possess potentially changing value systems depending on their peculiar spatiotemporal position in time and (H)istory, then processes of political decision-making are not adequately conceptualized by means of generalizations. Rather is it necessary to actually explore agency and power in the concrete empirical situations of

political decision-making under investigation. For my theorization of transnational electricity governance this fourth argument is significant insofar as the planning of large electricity utilities often goes along with unmet deadlines or faulty materializations (Graham and Thrift 2007). Insisting on the delimited empirical 'anchorage' of systemic realities shall thus lend political decision-makers and practitioners the sensibility for reducing risks related to infrastructure planning by taking the local level of decision-making more seriously.

(5) To conceptualize the dynamic relationships that exist within this arrangement reason five will also be relevant for my own work. It turns on the precedence of change over stability Strange observes that articles of agreement made between states are always one step behind the actual reality of political relationships. By advising the researcher to contingently trace the *actual* changes that took place in a specific spatiotemporal setting she provides me with a relevant starting point for a more fine-grained analysis of transnational electricity governance. I have highlighted before that I shall further deconstruct the elements brought to bear by Strange (i.e. agents and structures). Specifically, I will criticize that starting with a matrix where the 'relevant components' are determined *in advance* (Strange 1994a, 232) will lead to biased results because the agency of newly emergent or otherwise unforeseen elements is prone to be systematically overlooked (Latour 2005, 31; Law 2004). Following her interest for small-scale processes and iterative adjustments, I shall thus develop on her argument and explore the possibilities of laying bare *individual* entities that participate in the constitution of transnational electricity governance.

(6) Together with state and market actors technological innovations are also part of the group of entities that Strange finds most important for the constitution of sectoral policies. In her disquisition on change in the international political economy, Strange complained about conventional IR theories neglect of technology. She identified technology as a highly dynamic force for structural change, one that has the power to disrupt the agency of political and private actors via the alteration of transaction costs (Strange 1991, 38). However, and while I agree with her about the redistributive consequences of technology in IR as I explained above, I also identify limitations within Strange's theorization, notably her ontological assumptions about the nature of the state, the markets and technology as three distinct and mutually exclusive factors in the international political system (1991, 38-39) and her assertion that technology is to be regarded as exogenous to the international political system (1991, ibid). In my view, her theorization fails to

address the endogenous importance of technology for world politics. In what follows I shall contend that ‘mattering’ the governance of transnational electricity infrastructure (in the style of Van Wezemael, et al. 2011b, 'mattering the res publica') in the sense of attributing more intrinsic importance to inanimate matter in the constitution of new technologies and its political governance provides a good corrective for the already considerable theorization of technology in the literature of Susan Strange. Technology’ - just as ‘markets’, ‘the state’ or ‘society’ - is then more appropriately and productively conceptualized as a specific arrangement comprising “forms of knowledge, skill, diagrams, charts, calculations, and energy which make its use possible” (Barry 2001: 9). It thus consists not only of the technical devices but also of the humans and other interacting material artifacts who operate them in a ‘hybrid collective’ (Barry 2001: 9). A hybrid collective is an assemblage made up of individual *human* and *nonhuman* entities. Technology is therefore always dependent on and contingent from the existing relations among these entities. Only on the basis of a close scrutiny may it therefore become situatively regarded as state-related, market-related, or of societal relevance.

**Practices Turn in International Relations**

Contemporary ‘praxiography’, that is a theoretical approach that references an ethnographic study of practices in IR, is the last approach that I want to introduce in this subchapter. There exist many different conceptualizations of ‘practices’ and different ‘theories of practice’ associated with it in the social sciences and the humanities. The least common denominator of practice theory is a certain conception of ‚practices’ as “arrays of activity” (Schatzki, et al. 2001, 2). As Freeman et al. formulate it: “Practices are actions: they seem to consist in people doing things. Action of this kind is both social and material. Note that the meaning of a given behavior is necessarily socially derived: practices are very often carried out with others, and by reference to norms and standards that others, both participant and non-participant, will recognize. We cannot properly think of action as individual (‘individual action’); meaningful action is always socially informed, such that all action - and practice – is to some extent interaction” (Freeman, et al. 2011, 21).

For the present review, I shall not try to give a comprehensive overview of what it means to study practices in such diverse academic disciplines as philosophy, cultural theory, history, sociology, anthropology and science and technology studies (Schatzki, et al. 2001, 1) Instead I will confine

myself to review the works on a number of contemporary "praxiographists" (Bueger 2011b) from the field of IR (Reckwitz 2002, Adler 2005, Pouliot 2008, Abrahamsen and Williams 2009, Adler and Pouliot 2011, Freeman, et al. 2011, Hellmann 2011, Bueger 2011a, 2011b) and highlight the importance of their findings with regard to the six dimensions that I derived from Strange and that I find particularly relevant for the investigation of contemporary electricity networks. Again, I put the number of the reason at the front of the paragraph for enhanced legibility.

(1) A further, though still partial, opening of the black box of the unitary state actor can be witnessed in IR since the mid-2000s, when "political scientists [have] started to focus on practice as the smallest unit of analysis" (Bueger 2011a, 11, 2011b, 1). The rationale for what has been termed the 'practices turn' (Schatzki, et al. 2001) in IR has its origin in the domestic or national realm theorized by organizational theorist Wenger (1998) and it consists in gaining a more fine-grained appraisal of the commonplace particles that constitute authoritative policy-making (pioneering: Adler 2005). The interest of practice theorists lies in displacing the notion of 'authoritative governance' *away* from closed unitary actors such as domestic or national *institutions* to everyday *situations*, and *activities* of policy-making where it is possible to integrate a broader spectrum of agents (Adler 2005, Freeman, et al. 2011, 127, Bueger 2011a, 1). In a sense that bears resemblance to Strange's consideration of the societal bargains that underlie political regulation (Strange 1982, 496), the attention of practice scholars is thus drawn to the *dynamic* vs. the static elements of political decision-making and specifically to the *interactions* between humans who together may also come to form *durable* (vs. ephemeral) patterns. Examples from IR security politics are, amongst others, the balance of power or security community patterns (Adler and Greve 2009).

Theorizing transnational governance from a practices perspective involves asking the question of the participation of business, NGOs and states in governance patterns but the focus is not on determining the *share* of these preordained groupings in governance responsibility (Abbott and Snidal 2008, 8). Rather it is about determining their *coexistence* and their *overlaps* that are regarded to shape governance patterns and arrangements (Adler and Greve 2009, 60). In the view of praxeography governance arrangements emerge out of the interplay of actors pertaining to business, NGOs and states. They are conceived as "distinct mixtures of practices" between humans and things (Adler and Greve 2009, 59) with the capacity to form dynamic 'social' collectives. This additional opening of the black box of the state - and by extension of other

political institutions – in social theory is consequential for contemporary IR theorizing in that it provides an a-historic and de-territorialized thinking tool for the analysis of transnational electricity governance.[17]

Emauel Adler belonged to the first IR scholars who made the work of organization scholar Etienne Wenger viable also for the study of "transnational" and "even global communities of practice" (2005, 15, Bueger 2011a, 13). He argued that by engaging more with the local IR would be better able to explain also the global: "The closer we get to the level of practices, in fact, the more we can take the international system as a collection of communities of practice; for example, communities of diplomats, of traders, of environmentalists, and of human-right activists" he states in *Communitarian International Relations* (Adler 2005, 15).

The relevance of this statement consists in the acknowledgement that state boundaries are historically contingent political demarcations made by man and do not exist by themselves. They are social constructs (Wendt 1987) that have no *natural* existence. As I have highlighted with regard to regime theory and Strange's work on the international political economy, the likelihood that contemporary political issues are confined to state boundaries is fairly limited due to the enormous technological developments that have taken place in the last 20-30 years. Practice theorists in IR make a contribution to displace the making of authoritative decisions away from the unitary state actor (Büger and Gadinger 2007, 93).

However, their conceptualization of decision-making is still grounded in the ontological assumption that individual actors and other entities may be referred back to one *dominant* area of social, technical or political life that then enter into conflict with other areas, e.g. traders, environmentalists, governments. In other words, both Adler and Strange address the topic of political practices on the grounds that every individual actor or nonhuman entity is seized by one dominant call for social regrouping and that other commitments are subordinated to this dominant call for regrouping. Whereas in the case of Strange these dominant structures are the primary and secondary power structures (1994a), Adler situates these areas as in diplomacy, trade, environment, human rights etc. (2005, 15). Thus, and despite the fact that he theorizes the potential coexistence and overlaps between different communities, he still assumes the individual communities to be homogeneous and strongly stable over time. The fact that members of individual communities may be participants of other groupings as well and how this affects their

[17] A-historic in the sense that it is not rooted in the acceptance of historically contingent social concepts as states, administrative state boundaries, sovereignty as a means of in-depth political analysis.

goals and courses of actions is not theorized.

(2) It becomes visible on the basis of these reflections on the nature of the state, that a reconceptualization of its territorial-administrative boundaries echoes another key concern of practice theory in IR: the question of how the state is situated within a larger social and political environment (Büger and Gadinger 2007, 90). Before practice theory gained significance in IR, scholars Rosenau and Czempiel suggested to reconceptualize the relationship between the state and transnational authorities by formulating their "governance without government" hypothesis (1992). While this seminal volume by Rosenau and Czempiel made a relevant contribution for appraising the changing nature of state-society interactions across the borders of the nation-state it has nevertheless left the assumption untouched that authoritative decision-making in the social sphere (e.g. markets etc.) is externally *sanctioned* by formal political institutions. Practice theorists in turn recognize that formal political institutions influence private sector regulations on the basis of the possibility spaces that they open up for political thinking:

> "The invention of a political nucleus – the formal institution – has undoubtedly made incomprehensible the political world as a whole. It is however, the removal of the nucleus that genuinely creates the interrogative of how the nucleus relates to its environment. […] Speaking metaphorically, one is relying here on an analogy that suggests that one can understand the blood circulation of humans better by first dissecting the 'heart' (the formal nucleus) from the vessels (informal sphere), without appreciating that one is not possible or even understandable without the other. To understand the political 'organism', however, one must understand the beating heart and the circumfluent bloodstream as a unity. Equally should formal and informal institutions not be thought about in isolation but as being engaged in a [continuous] interplay" (Bueger and Gadinger 2012, 7 own translation from German).

Contemporary praxeographists in IR thus perform two key moves when they theorize the notions of state and state politics: on the one hand they criticize and relativize the notion of the nation-state as a unitary 'actor'. And on the other hand they redesign the scope for political action in a way that both further confines and extends its reach: confinement rests on their interest in the embeddedness of agency with the peculiar case(s) at hand. And extension results from the conceptualization of the local and the global as points on a continuum that only gain meaning in relation to practices of interaction. When tracing back political decision-making to practices the very notion of a political process comes to encompass multiple (but contingent) geographical, temporal and functional actors thus almost automatically transcending the formal administrative

boundaries of states. In doing so it also transcends other traditional levels of IR analysis: "As soon as one looks into practices, it becomes difficult and even impossible to ignore structures (or agency), ideas (or matter), rationality (or practicality), and stability (or change)" (Adler and Pouliot 2011, 4). Studying transnational electricity governance from the perspective of practices means to posit that (an) action cannot be brought about by an individual actor alone but that it is the result of a *situated* collective endeavor among humans. In this collective, structures are automatically part of the analytical picture, hence there is no analytical value for a distinction between agency and structure in this conceptualization of transnational electricity governance, rather do several diverse actors and objects together create durable patterns of interactions ('power structures' in Strange's terms (1994a) by their movements of association.

(3) The third way in which agency should be reconceptualized in IR regards its conventional recourse to rationality as an explanans for political decision-making. The rejection of a unitary state actor and the introduction of a more fine-grained analytical approach grounded on shared practices between a diverse set of actors translates into the necessity of correcting the canonical process-analytical shorthand of cumulative - or in its culmination: *teleological* - developments with a more situated understanding of decision-making and agency in transnational governance. Here, practice theory speaks to Strange (1976a, 1976b, 1996, 20) as she says that human intentions always collide with the rationales of specific historical and political settings. Practice theory theorizes this relational component inherent in political decision-making even more explicitly than Strange by substituting states, markets and technologies with practices as the smallest unit of political analysis (Bueger 2011b, 1) and not "states, markets and technologies" (Strange 1991). In the setting sketched out by practice theorists it becomes thus more visible how the goals of human agents are not a given or even stable but continuously *forged* in the *process* of *contingent* social interactions: that is in the encounter of individual value systems in human practices (Adler and Pouliot 2011). With regard to my analysis of transnational electricity governance the specifications made by practice theory on the rationality of state actors and conditions of uncertainty in political decision-making processes are relevant because they redirect our attention from the desired and thus *normative* dimensions of public policy making towards the *actual practice* and thus towards the complex daily routine of policy-makers (Freeman, et al. 2011). However, and as I argue further on (c.f. next chapter), the planning of large technical issues is often erroneously thought of as unproblematic and as fitting smoothly into the functional

needs of intentional human actors. This assumption however finds itself harshly revised in instances of infrastructure disruption. In these instances the autonomy and the intentionality of human actors vis-à-vis technical developments is fundamentally relativized. I therefore argue that the fact that technical objects possess distinct characteristics and dynamics makes it necessary to include them into the analysis of transnational governance (Bennett 2005, Braun and Whatmore 2009, xxii; xxix).[18] Focusing our attention exclusively on conventional notions of intentionality, functionality and abstract contextual generalizations in analyzing political decision-making in large transnational infrastructure planning, would mean to leave the aspect of the *criticality* of large infrastructure planning undertheorized.

(4) The fourth way in which practice theory helps to reconceptualize agency in transnational governance is by allowing a flexible theorization of stability and change in global politics. By drawing on the notion of practices as the smallest unit of analysis (Bueger 2011b, 1) stability is defined as the continuous perpetuation of interactions among individuals (Bueger and Gadinger 2012, 11). If we conceive of practice as a "nexus of sayings and doings" (Schatzki 2005, 495) then formalized social groupings as institutions, organizations and states become the place or site where several diverse actors continually *exercise* a specific set of practices (Bueger and Gadinger 2012, 11). In this process diverse practices complement and mutually perpetuate each other, thereby keeping the institution/organization/state *alive* (Bueger and Gadinger 2012, 11). Thereby the controversies that arise with regard to the perpetuation or abrogation of certain practices point to the fact that actors possess different intentions and motivations to participate in specific practices (Bueger and Gadinger 2012, 11) and that different communities of practice therefore compete with each other in transnational governance.

(5) The fifth way of reconceptualizing agency in transnational relations emanates directly from the flexible conceptualization of stability and change advanced by practice theory. If institutions are conceived as a conglomerate of social practices that complement and perpetuate each other it becomes clear that political decision-making processes cannot be conceptualized productively as the outcomes of equations like "a + b + c + d" where every letter signifies the circumscribed practices of one distinct social group and the plus sign signifies the additive

[18] This is however not the same as arguing from the viewpoint of technological determinism (c.f. Williams and Edge 1996: 868).

accumulation of those groups in a linear development process (the analogy is drawn from Latour 1991). In lieu thereof practice theorists take the task of accounting for the *coexistence and overlaps between groups, and thus* for the constitutive interpenetration of interacting subystems seriously (e.g. volatile and recurrent patterns of practices). However, they only include humans in their patterns of interactions and regard things merely as instrumental facilitators of human actors. As a corrective I shall thus argue that decision-making is better understood as a *meshwork* or hybrid arrangement of actors *and* things that are reflexively *intertwined* and who only become empowered to deploy agency in conjunction with each other.

(6) As I stated in the previous paragraph, governance as viewed from the praxeographers is not *intrinsically* affected by material objects. These may still be *facilitators* but not active agents in transnational energy governance. This is because practice theory endorses the notion of intentionality of actors and the relevance of speech acts for the development of agency in international relations (Buzan, et al. 1998, Adler and Pouliot 2011), thereby leaving the 'dark matter' of social relations unaddressed.

**Interim conclusion**

The intent of presenting a review of the practices turn in IR and to put it in relation with Susan Strange's contributions on the nature of transnational governance was to present a refinement of the conceptual instruments that may provide IR scholars with assistance in theorizing the reorganization of transnational electricity systems. In comparison with Strange's International Political Economy approach, the practices turn implies a further step in the opening of several of the traditional concepts and units of analysis of IR as they have been formulated in International Regime Theory or Susan Strange's approach to the International Political Economy.

To recapitulate, the main contributions of practices theory to the theorization of transnational governance in energy are: (1) the attention to a dynamic constitution of social aggregates and political agency within performative and intersubjective practices that involve humans, their knowledge backgrounds and instrumentally deployable objects. Strange suggests that the entities involved in the performance of global politics must not necessarily pertain to the realm of the state alone. However, practice theory goes a step further because its *de*-constructivist approach does more justice to the spatiotemporal contingency of concepts denoting collectives ('the state',

'the market') than Strange. Practice theorists are more sensitive to the historicity of these concepts including the analytical implications for the study of transnational politics. They address it explicitly and make it visible by suggesting a fresh vocabulary for the analysis of political decision-making that is organized around practices (Büger and Gadinger 2007).

(2) Positing that (political) agency is developed in situated practices reduces the analytical emphasis on a distinction between agency and structure and brings the nature of their mutually constitutive nature closer to the center of attention. The relation between a state government and its social and political 'environment' (Bueger and Gadinger 2012) is theorized explicitly. Practice theorists come close to positing an *intrinsic* relationship between agents and structures in a way that almost completely questions any analytical switching back and forth between the two concepts of agency and structure (Giddens 1984; Wendt 1992) - if it were not for their neglect of the *intrinsic* role of material objects.

(3) Positing that the interests, ideas and values of human agents are forged intrinsically in the process of situated action, which does not behave in a linear way, practice theory also reconceptualizes the importance of rational choice theory for the analysis of political decision-making processes. With regard to the theorization of energy and related critical infrastructures we will see that this is an important move to achieve a more integrated and realistic perspective on the planning, construction and operation of electricity infrastructures.

(4) Even stronger than Strange, praxeographists in IR emphasize the importance of change and instability in international relations. The concept of practices is here also very useful because it allows scholars to formulate the theorization of change around the variability of practices themselves and the multiple possibilities of interaction between different types of practices. This theorization is even more flexible than the one posited by Strange because it allows for the combination of different practices into an overall pattern of interaction without the need to categorize the type of practice under a specific sectoral category.[19] Rather, can different elements stemming from different sectoral categories be combined to a new category, thereby paving the ground for a dynamic theorization of innovation. As I have stated before, however, practice theorists still use sectoral categories a priori when they state e.g. that traders and other delimited

[19] Even if many practice theorist do so (e.g. Andersen and Neuman 2012).

groups participate in certain practices (Adler 2005, 15).

(5) By accounting for the *iterative* constitution of agency in transnational governance, praxeographists in IR count among those scholars who also take the value of the empirical case seriously they are able to account for the intertwinement of dynamic and lock-in elements (stop and go) in political decision-making as well as for the constitutive entrenchment of different kinds of practices in different spatiotemporal contextualizations (interacting subsystems)[20]. In other words, they provide initial scaffolding to account for non-linear interactions in transnational governance on the basis of their situated analyses of circumscribed empirical cases.

(6) In this setting of situated governance practices, technical objects and technologies play a role as well. However, it is limited to instrumentally 'facilitating' the conditions of governance (Buzan, et al. 1998, Andersen and Neuman 2012).

[20] Again, despite the ontological predominance of certain calls for social regrouping (Adler 2005, 15).

## 3. Critical Infrastructures and New Energy Geographies

The last chapter has outlined the dimensions of transnational energy governance that are addressed from the point of view of three research strands of IR Theory: International Regimes, International Political Economy and Practice Theory. In this chapter I present a perspective on transnational energy governance that is informed by new scholarship in the field of Geography, Critical Infrastructures and the Built Environment. The chapter is designed to bring the territorial and spatial situatedness of human practices even more to the fore by going more in-depth on the active role of 'objects' and specifically 'technical objects' in transnational energy governance. Specifically I want to shed more light on what it means that "technical objects are endogenous to political decision-making" (Latour 1991, 1992, MacKenzie and Wajcman 1999, 9, Winner 1999, Pinch 2010) and explore how human actors and technical artifacts co-evolve in transnational energy governance thereby co-producing it. This question is not trivial. Despite the fact that the study of transnational energy governance has profited by a turn towards practices that allowed for the further opening of the black box of political decision-making beyond agency and structure, the role of nonhuman entities in political decision-making is still only very elusively addressed. Few IR scholars (e.g. Schouten 2009, Bellanova and Duez 2012, Koddenbrock and Schouten 2012) engage in the discussion of 'technology' as "an assemblage of heterogeneous elements linking the technê with procedures, regulations, institutions, discourses, perceptions and attitudes" as proposed by Deleuze (1989) and Foucault (1995). More often technical objects are "relegated to the status of resources or tools, entering political theory only to the extent that [they have] instrumental value but not in terms of [their] constitutive powers" (Braun and Whatmore 2009, xv) - which in practice amounts to negating the 'social life of things' (Appadurai 1988). In this chapter, I thus want to look at scholarly contributions that increasingly give evidence to the fact that electricity infrastructure might not be just technical infrastructure but a central organizing principle of modern societies (Barry 2001, 22, Beck 2007). To give weight to my words, this chapter is not organized around the six points devised earlier but starts with highlighting the structuring role of technical objects in transnational energy governance. The aim of the chapter is to show how technical objects operate distinctions in social relations thereby creating new hierarchies in transnational energy governance compounds. In other words, 'flat' relational networks replace traditional multi-level system conceptualizations of transnational energy governance. The importance of an individual unit is then not dictated by the historic development but by actual salience. I will illuminate this conceptual difference by drawing on

disruptive events in the transnational governance of electricity because this is when the organizing power of technical objects becomes visible best.

**Technical objects in transnational energy governance**

It is not new for IR studies in transnational governance in general to pinpoint technical breakdowns and other sorts of disasters as the key drivers of transnational standardization (Hardin 1968, Held 2006, Abbott and Snidal 2008, Mattli and Woods 2009, 22-24, Barry 2012, 4). However, the approach that I take here differs significantly from those of earlier contributions in that I do not regard (infrastructure) breakdowns or failures as "preceding [and thus causing] the development of international standards" (Barry 2012, 4 on how those approaches conceptualize the relationship between disasters and regulation). Instead, my argument insists on the importance of addressing the *sociotechnicality* of infrastructure breakdowns, i.e. the *intrinsic* relation that exists between technical infrastructures and the social. The unfolding of an infrastructural breakdown is always heavily dependent on the behavior of human actors such as consumers, constructors etc. as well as simple technical hazards. Often it is even the conjunction of both behaviors that leads to breakdown. It is seldom immediately visible to the observer how exactly those elements hang together. In this perspective, then, technical breakdowns are not just incidents but downright systemic failures concerning an assemblage of heterogeneous elements that surround a specific technical infrastructure (Barry 2012, 22).

Technical infrastructure is directly involved in the enactments of particular social constructs such as electricity systems, communication networks, but also identities, cultural values, ways of life etc., such as urban resident lifestyles or online workforces. (Aradau 2010, 2). It is by its mediation that specific social constructs are able to emerge at all. Despite being made invisible by their lock-in into "pipes, cables, conduits, tubes, passages and electric waves" (Kaika and Swyngedouw 2000, 2) technical artifacts intrinsically support us in performing our tasks and projects every day anew. In little, technical artifacts *perform* small-scale actions for us: " [...] kettles ‚boil' water, knifes ‚cut' meat, baskets ‚hold' provisions, hammers ‚hit' nails on the head [...] (Latour 2005, 71). In "large", you just need to "turn the faucet for a drink of water and you use a vast infrastructure of plumbing and water regulation without usually thinking much about it" (Star 1999, 380). On their own humans could not carry out those actions. They could not even think of the possibility of carrying them out this way before technical artifacts produce the possibility for it. It is by making use of these different small and large technical artifacts that we

humans naturally *blend* them into our subjective and collective historical realities. We lend them the power to temporalize and spatialize our lives by allowing them to reorganize our relations to the technical and by extension also our relation to the social (Braun and Whatmore 2009, xxii). Hence, technical artifacts not only *support* the process of reification and stabilization of social and political communities in everyday life but they *permeate it and thus mediate it intrinsically.* Thereby allowing for "history and time [to] become possible" (Latour 1992, MacKenzie 2002, 2)[21]. In other words, I advance here that transnational energy governance is reflexively intertwined with technical infrastructures (Braun and Whatmore 2009, xxii).

"Cultures, sociologies and geographies of urban 'modernity'" are unthinkable without the contribution of networked *hard*[22] transport, water and sewage, communications, and energy technical infrastructures" (Star 1999, 380, Marvin and Graham 2001, 19). In addition, recreational, health or cultural infrastructures in the form of buildings as well as security infrastructures in the form of fences, sidewalks, different dedicated tracks, and security and surveillance cordons around banks, jewelers or embassies also intrinsically characterize the way in which people live and circulate in different times and different locations.

Concurrently, social and political communities are constitutive to technical modernization and progress because technical infrastructure is always "built on an installed base" (Star 1999, 382). In other words, the advent of technical discoveries and innovations "come[s] from behind" (Braun and Whatmore 2009, xxii). Technical infrastructure thus not only order people's lives but they also emanate from those lives, particularly from *existing* technical artifacts and the practices that are built around them.

For the study of transnational governance this means that we have to imperatively include also the behavior of technical objects in our analytical endeavors to be able to formulate energy policies that suit our contemporary ways of life. In terms of the concerns of this thesis with transnational electricity infrastructure I find it important to highlight vividly the distributive consequences of technical artifacts, which arise out of the capacity of nonhuman artifacts to reorder hierarchies of relations in transnational electricity governance (Aradau 2010, 16).[23] Since "technology plays a formative part in making up what we are as humans" (Barry 2001, 8) - and

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21 c.f. also also Kaika and Swyngedouw 2002 on technological networks as mediators of social life.

22 The term „hard" infrastructures is used here to denote specifically physical infrastructure. I introduce this distinction here because in common language all kinds of social and political institutions in place for economic, trade and other kinds of regulation are also sometimes referred to as ‚infrastructures' of society (Joskow 2006, 2), but this is not how I intend to make use of the term.

23 I will give some empirical examples in chapter five where I analyze major blackout events.

vice-versa -, I argue here that it is more productive to conceptualize it as specific *arrangements* which comprise "forms of knowledge, skills, diagrams, charts, calculations, and energy which makes its use possible" (Barry 2001, 9) instead of attempting to artificially distinguish it from social and political collectives as e.g. Strange does (1994a).

This critical discussion of the nexus between the technical and the social from a New Geographies perspective challenges the assumption that technical innovations flow from the genius of an individual inventor's mind (MacKenzie and Wajcman 1999, 8) and therefore also the idea that a successful energy transition is achievable by the introduction of the few 'right' renewable power plants. The premise that one or several individual *subjects* lie at the heart of transnational electricity governance is thus fundamentally altered: If technical innovations represent and emanate from previously existing forms of technical knowledge, skills and practices (Star 1999, 382-382) that not only include several subjects but also several *objects*, transnational governance arrangements are vast but circumscribed assemblages that are social and technical in kind.

**Controversies in transnational energy governance**

The reinterpretation of the concept of transnational energy systems as a sociotechnical assemblage increases the conceptual importance of "public discussion, choice, and politics" for advancing a specific materialization of new technical infrastructure (MacKenzie and Wajcman 1999, 5).

Different cultures, societies and geographies of urban modernity - that are all conceived as heterogeneous constellations of humans and nonhumans - produce different kinds of infrastructures. For example, different energy matrixes in different geographic regions and individual countries of the world present different electrical features and consumption patterns. On that account, any innovation cannot happen *at any time* or *anywhere* (Bennett 2005, 457)[24] but is intrinsically related to the existing relations within a contoured sociotechnical assemblage. The interactive settlement of public disagreement over technical objects and related technological innovations thus constitutes a fundamental feature of infrastructure development processes of any

[24] However, as technological innovation is based on the concurrence of specific component technologies and specific social and cultural situations rather than on a particular man or woman, any one or more persons can – in principle – participate in the discovery of an innovation independently; at different or identical points in time (D. MacKenzie and Wajcman 1999: 8).

kind. In this regard it is however necessary to differentiate between the kind of negotiation and settlement that is intended by the sociology of association (Latour 2005) and the one drawn by more classical approaches to IR. In the former, technical objects are not merely the object of human deliberation (Braun and Whatmore 2009, xxii). Rather are controversies settled through constructive frictions in an actor-network consisting of humans and nonhumans (things, concepts, ideas) (Latour 2005). In this perspective, technical objects intervene in the settlement of controversies when they influence the form and direction that development paths may take (Latour 2005, 71). They do so by supporting or objecting those development paths through their particular way of functioning. This view is fundamentally different from more traditional perspectives where humans settle controversies among themselves, by human deliberation. Barry gives a telling illustration of how objects may intervene by themselves in the settlement of controversies in his study of metallurgical materialist politics:

> "Indeed, from the point of view of the metallurgist, the properties of metals cannot simply be deduced from fundamental physical principles. Alloys cannot be understood as combinations of pure substances, and the behavior of metals in the conditions encountered in power stations or aircraft is quite different from any laboratory setting or simulation. […] The metallurgist expects that materials will be opaque, that the case will make a difference. In this way, the metallurgist is a good materialist, aware that materials will always in some way, be resistant to external forces and will generate their own effects" (2010, 91).

We can see from this particular example how metals acquire agency in relation to a constellation of other actors and things that surround them. It becomes clear how nonhumans directly intervene in the form that the settlement of a controversy takes: their faculty to corrode in specific contexts might for example impinge on the construction of an aircraft or a power plant and thus potentially mediate adaptations in the political regulation of construction materials for certain areas or regions of application. An alternative example more attune to my research endeavor would be the capacity of transmission lines to carry electricity load only to a certain pre-defined degree (high, low or medium voltage). Their incapacity to carry electricity beyond the degree foreseen by planners at the point of construction will impinge on the working of the grid under disruptive conditions, meaning that bottlenecks might arise in the grid if electricity cannot be dispatched via certain specific transmission lines. Another example could be the volume of a hydroelectric power plant's water reservoir which impinges both on the generation capacity of the plant and the settlement patterns of humans and animals in the area. Eventually this characteristic will impinge – in the first case - on the decision to construct additional transmission lines, i.e. the number and

voltage levels of additional lines. In the second case it impinges on the decision to locate the power plant.

From this we see that the *news* that technical artifacts bring to the political community (Latour 2005, 71) is that they reorder governance hierarchies: humans such as engineers or objects such as transmission lines gain importance in relation to political decision-makers due to the existing *materiality* of governance, that is, its material characteristics and dynamics that impinge on the practices of governance. In spite of this, things and other nonhumans obviously do not play a role *no matter what* the context is that we are looking on. Their characteristics are only relevant as long as they make a difference (Latour 2005, 71) with regard to a specific development path. For example, the faculty of specific construction materials to corrode may be relevant with regard to the safety measures that apply to the construction of an aircraft of power plant. But it is not automatically relevant with regard to other practices of social and public life. Neither is the carrying capacity of an electrical transmission line important in a distributional setting where most people rely on personal, diesel-fired auto-generation units. After all, "it is not inevitable that the behavior of materials should be of interest to others or be the object of disagreement across a range of sites and settings within which political matters are addressed" (Barry 2010, 109).

Conceptually, however, the fact that objects may 'object' specific development processes fundamentally relativizes the notion of controversy as well as of the rationality and the purposefulness of human actors. First, the active intervention of objects in controversies relativizes the relevance of rationality and deliberation in the constitution of the social. Second, the distinct characteristics and dynamics inscribed in technical objects make it necessary to rethink the significance of rationality and human deliberation by human actors since characteristics and dynamics are insufficient proxies to the actual logic of transnational governance (Bennett 2005, Braun and Whatmore 2009, xxii; xxix).

To summarize, technical infrastructure systems are thus far from being the neutral object of human deliberation despite their recent banalization by the wider public (Graham 2010b, 8). As Aradau puts it: "'Things' are neither empty receptacles of discourses nor do they have essential characteristics that set them apart from humans, but are themselves agential and emerge in relation with material-discursive practices" (Aradau 2010, 3). They are affected by considerations of material asset and wealth distribution as well as by ideological norms and beliefs (MacFarlane 2010, 139ff.). For this reason, I contend that it is highly inappropriate to *a priori* discuss technical

infrastructures as exogenous and instrumental devices in public service provision as this might mean ignoring the "worlds of 'networked infrastructure" (Marvin and Graham 2001, 19-20).

**Sites of transnational energy governance**

After having explained the nature of the intrinsic relation between humans and things, I now want to discuss the relevance of the spatial and temporal demarcations operated by technical infrastructures for the constitution of transnational governance. We have seen in the previous chapter that there exist different perspectives on how a political community is instantiated. In a Critical Infrastructures perspective it is contended that what instantiates and demarcates a political community in transnational energy governance is the formation of a contoured human-nonhuman arrangement around a specific technical energy infrastructure. This means that there exist communities around water power, wind, gas or else. These can be exclusive but in most cases they have important overlaps which is why energy governance is so difficult to come to terms with. Rule-based behavior in transnational governance is thus not merely based on man-made "social contracts" (Braun and Whatmore 2009, xv) in the sense of Hobbes (1651) (Gaskin 2009), Locke (1689)(Ashcraft 1987), or Rousseau (1762) (Rousseau 2001) or on the commitment of nation-states as posited by the early regime theorists. Rather does it hinge on a mixture of sociotechnical "teamgeist" that embeds sustained performance (Van Wezemael 2008b) and the constraining and enabling characteristics of technical electricity infrastructure (Bennett 2005, Aradau 2010).

This may be illustrated by means of the recent electricity market reforms that have taken place in many countries all over the world from the 1990s onwards (Sioshansi and Pfaffenberger 2006, Batlle, et al. 2010) and that have significantly affected the way in which for example blackouts unfold nowadays: The reform measures taken by national governments separated the vertically integrated domestic electricity utilities into separate branches for generation, transmission and distribution and changed logic of operation of what were earlier geographically defined monopolies (Kirschen and Strbac 2004, 2, 7). The logic of the catchment area of a utility, that is, its territorial coverage from generation to consumption was substituted by the logic of market efficiency in which each player executes only that operation for which he is able to offer the best quality at the lowest price. Concomitantly, many countries introduced privatized some or all component parts of the industry that were publicly owned (Kirschen and Strbac 2004, 7). They

thus introduced the notion of market competition and multiplied further the number of relevant actors within the given geographical areas. While the reform concerns first and foremost localized power utilities and their domestic jurisdictions, it inherently affected transnational governance as liberalization helped electricity companies forge relationships with an increasing number of inter- and transnational suppliers, customers, and decision-makers (Bialek 2004). Due to this concomitant process of liberalization and transnationalization of energy companies "resource rich regions were physically and socially connected to regions that are high in their demand in energy" (Barry 2013, *forthcoming*, 1). Through their transmission and distribution capacities technical infrastructures *actively* intervene in modern energy landscapes, which find themselves reordered both materially and ideationally (Ghosn 2009) across administrative state boundaries. In short, the building of new infrastructure goes along with the forging of new social collectives which are drawn together by these material elements.

**The re-configuration of transnational energy governance**

Evidently, as domestic electricity governance systems expand both socially and technically in the course of energy-related planning and construction the scope of potential blackout events is also broadened: as *domestic* technical artifacts ramify into the realm of the *transnational* by means of their interconnections with "countless other elements, gestures, practices and institutions" (Braun and Whatmore 2009, xxi) the distinction between the "state" and the "global system" made by traditional political science approaches becomes inadequate. The notion of an antagonistic duality consisting of national state vs. global environment must be replaced by the idea of a continuum in which the local and the global form one integrated object of analysis (Latour 2005). What pertains to a political collective or not is then not determined on the basis of predefined administrative boundaries but on the basis of human-material conjunctions related to the particular technical infrastructure under scrutiny.

We must acknowledge that distinctions between what *is* naturally and what *is* socially are not pre-given, but are materially and discursively constructed (Aradau 2010, 3). Through liberalization and internationalization the notion of political governance experiences a reordering away from its "sub-jects" and towards its "ob-jects" (Stengers 2010). The duality between agents and structures is bridged. What is achieved by replacing this duality with the notion of a local-global continuum is thus a definition of agency that is less biased towards particular *dimensions*

of *political* energy governance and more inclusive of variegated forms of agency within it. At the face of these changed conditions of operation in modern energy landscapes (Ghosn 2009) the question of the politically authoritative settling of negative externalities related to energy production and other network activities appears of renewed interest. In what follows, I contend that technical infrastructures are at the heart of transnational energy regulation. This is because some of their specific properties and dynamics may cause negative externalities from the "realm of failure, management, control and coordination problems" (Mayntz and Hughes 1988) and these negative externalities would then require to be regulated by governmental authorities provided that they may compromise the functioning of the societies they govern (Hardin 1968, 5, Barry 2001).

With reference to Silberberger et al., I contend that transnational electricity governance indeed takes place "in between those entities, in the productive tensions between various and heterogeneous knowledge backgrounds, between global tendencies for innovation and local prerequisites and settings" (2010, 289). I hence argue that the focus on spatially and temporally confined technical infrastructures – as the short-circuited power plant or grid component in a blackout – provides an adequate empirical frame for the ascertainment of the exact participants of governance endeavors in the field of transnational electricity. Put in the words of Latour:

> "The laws of the social world may exist, but they occupy a very different position from what the tradition had first thought. They are not *behind* the scene, *above* our heads and *before* the action, but *after* the action, *below* the participants and smack in the *foreground*. They don't cover, nor encompass, nor gather, nor explain; they circulate, they format, they standardize, they coordinate, they have to be explained. There is no society, or rather, society is not the name of the whole terrain. Thus we may start all over again and begin exploring the vast landscape where the social sciences have so far only established a few tiny bridgeheads. For sociology the era of exploration may start again, provided we keep reminding ourselves of this motto: *don't fill in the blanks*" (Latour 2005, 246, emphases in the original).

As a result, acknowledging that transnational energy governance as a concept is only lent empirical substance by its "instantiating, mobilizing, realizing or incarnating into some sort of local and lived interaction" without previously positing what is hidden in it (Latour 2005, 169) is important because transnational energy governance cannot be understood if one focuses either on human actors or material artifacts alone. Rather transnational governance should be

conceptualized as "an infinite regress of relationships" between humans and things (following Bateson 1978: 242, cited in Star 1999: 379), never just an actor or a thing alone.

Conceiving transnational energy governance as a process that happens on a local-global continuum highlights the fact that "[state] politics is only one way of composing" a collective (Latour 2005, 171). - And it is not necessarily the most appropriate one with regard to the political question of transnational energy governance at hand.

To summarize, my analytical starting point for this thesis is "object-oriented" (Barry 2001, Latour 2005, Barry 2012). I will focus my attention on an electric infrastructure to analyze those transitional situations between one kind of transnational energy governance arrangement and another. As I have argued, bringing materiality and mid-range theorizing at center stage of the analytical picture and analyzing processes of governance reconfiguration on the basis of the interactions that surround a specific material artifact or infrastructure (i.e. electricity grids or power plants) is much more productive for achieving those *creative* and *innovative* solutions that are currently needed for the constitution of what the public has defined as a *sustainable energy future* (Club of Rome, Rio World Summit, Rio + 20).

Drawing on Amin and Roberts, I suggest that the emphasis on context, process and social interaction is mandatory to distinguish between valuable governance scenarios for the transition towards renewable energies or other challenges in contemporary energy policy. Amin and Roberts studied the whole body of literature on communities of practice and situated learning since the publication of Lave and Wenger's first contribution (1991, Silberberger, et al. 2010, 300). By comparing four settings of collaborative work they were able to show that, no matter how small, "the differences also stack up" (Amin and Roberts 2008, 365): "In the four settings of collaborative work considered the contrast in organizational, technical and spatial structure, together with those relating to the nature and intensity of social interaction, are significant enough to affect the nature of economic creativity generated" (2008, ibid). While it would go beyond the aim of this thesis to evaluate Amin and Roberts' typology for application in transnational energy governance, I take inspiration from their insight that creativity in transnational electricity governance is dependent on taking technical, social and political specificities of contoured technical infrastructures seriously. Otherwise governance regimes will incur the risk of missing their self-imposed marks of efficient harmonization and standardization.

**The emergence of new transnational governance arrangements in energy**

The currently debated energy transitions, which I consider as re-configurations of energy governance, provide a good case to study the emergence of new transnational governance arrangements on electricity. They represent an example for a typically Latourian transitional situation in which "innovations proliferate, group boundaries are uncertain, the range of entities to be taken into account fluctuates, [and] the sociology of the social is no longer able to trace actors' new associations" (Latour 2005, 11). The current debate about the role of renewable energies for our energy future is exactly one about the reconfiguration of groupings and the agency that goes along with it. But how does this happen? How do atomic waste, shale gas, transnational oil and gas pipelines, hydro dams, wind parks and solar installations to the electricity grid (to name only a selection) reconfigure transnational energy governance? To answer this question it is useful to start our investigation with a specific technical artifact and to look how at how controversies form around technical artifacts on the one hand as well as to how these controversies negotiate the relation between spatiality and temporality in transnational governance on the other hand (Marres 2010).

Because different policy alternatives exist with regard to making our energy supply more sustainable, great attention has to be given by the researcher to how a specific governance arrangement emerges. In practice this requires paying attention to the constituent units of an assemblage and the kind of relationship they entertain with each other. An assemblage or actor-network (Callon 1986, Law 1986, Latour 1987, 2005)– is understood as a heterogeneous arrangement of humans and nonhumans that as *a whole* is able to establish agency. The hyphen in the term actor-network is there to account for the hybridity and mutual intertwinement of the human and the nonhuman actors with the whole network (Law and Hassard 1999) and to highlight that behind every action there lies a network of other reflexively intertwined agencies (Latour 2005, 143). An analysis of this agential kind of genesis is complex. The French term for assemblage might be particularly suggestive here as the notion of "agencement" (Deleuze and Guattari 1987) manifests this processual dimension of transnational energy governance within which different human and nonhuman entities are assembled and *made to act* on the basis of their relational configuration. As Hardie and D. MacKenzie clarify "the notion of *agencement* […] involves a deliberate word-play. *Agencer* is to arrange or to fit together: in one sense, un agencement is thus an assemblage, arrangement, configuration or lay-out" for *action* (Hardie and MacKenzie 2007, 3, emphases in the original). This is also where the notion of human-nonhuman

controversies comes in. As I have argued, agency iteratively emerges out of the multiple and simultaneous relations between relatively circumscribed entities but who are all drawn together by a particular "matter of concern" (Latour 2005, 87). A matter of concern is an object whose contours and significance for the technical, the social and the political world are not pre-given but are subject to contestation by variegated human and nonhuman actors. Taking the example of atomic waste mentioned in the introduction, nuclear energy is a matter of concern in that different interpretations coexist and overlap with each other. For some proponents nuclear energy is a reliable supplier of peak load generation, for others it is a potential risk with large consequences for the natural environment and for humans in general, and for others it is the playground for innovative scientific research. It is then at the very moment when these interpretations become the object of negotiation in a public debate that Latour would speak of nuclear energy having achieved the status of a matter of concern (Latour 2005, 87). In this perspective, any object can become a matter of concern and it will from time to time. These interpretations are not matters of fact but they are contingent on spatiotemporal conditions and thus represent *concerns.* They are sociotechnical constructs pertaining to particular schools of thought.

The concept of *emergence* then points to the important fact that it is impossible to explain outcomes merely on the basis of the knowledge of the components that interacted. Often, one's expectations on how a controversy and thus a process would or could unfold are not met despite the knowledge on components and the experience with regard to frequent dynamics. For this reason it is theoretically and practically more productive to conceptualize transnational energy governance as *emerging* out of a *hybrid* "conglomerate of many surprising sets of agencies" (Latour 2005, 44), instead of laying the focus merely on inter-subjective performances between humans, allows for a better appraisal of the constitutive nature of objects within it. Therefore we may say that transnational governance is performed "in, by and through those intertwined human-nonhuman relations and that as a consequence everything is uncertain and reversible, at least in principle" (Law and Hassard 1999, 4). To summarize, it is not just the knowledge of the components, nor just the knowledge of the existence of a relationship between components that matter but it is the specific *enactment* of relations between heterogeneous components that makes a difference with regard to the con-figuration of a specific energy governance arrangement. Interestingly, the heterogeneous component parts may therefore be the same for different issues of political decision-making but it is the difference in *assembling* that explains the different measures that may emerge. This leads me to the overarching question of the next sub-section:

how is it that a specific new governance arrangement for transnational electricity becomes instantiated given the plethora of possibilities that exist?

**Enactments in transnational electricity debates**

The controversies that arise among different actors and objects who are engaged in performing an infrastructure, an infrastructure system or a governance arrangement are an illustration of the multiplicity of different kinds of infrastructures. To explain how a specific infrastructure becomes instantiated, I use the notion of enactment in a way suggested by Mol (Mol 1999). The term suggests that there exists not one reality within which political decision-making is exercised but multiple ones. The question of which reality is applicable for a particular case depends on the contingent spatiotemporal practices, Mol writes (1999, 2003). "Reality is historically, culturally and materially located" (Mol 1999, 75) in the sense that it is made of "intervention and performance" (ibid: 77). In the literature on the built environment, it is largely known that infrastructures can be regarded as "*processes* that have to be worked towards" (Graham 2010b, 9). As different kinds of intervention and performance exist, multiple realities begin to show which need to be negotiated among their creators.

Being during breakdown or operation, a multiplicity of actor-networks are simultaneously active for the infrastructure to perform the task it is designed for; the maintenance of each infrastructure system requires constant efforts by a wide variety of actors and objects (Graham 2010b, 9). As several entities might be simultaneously engaged with the same matter within multiple concurring relationships it is obvious that there arises room for frictions among the different participants as to how a particular *version* of a matter should be enacted.

The ontology of the multiple (vs. an epistemology of the multiple) posits that multiplicity is a characteristic of the object under study and not of the perspectives of the different human actors that play a role in the electricity sector. The crucial difference resides in the fact that the idea of multiple (epistemological) perspectives on renewable energies suggests that there are different *perspectives* on one single object (the energy landscape) that is – in its *essence* - always the same. While this *essentialist* approach known as "perspectivalism" has been and still is frequent in the Euro-American social science landscape (Law 2004, 65) it has recently been displaced in critical approaches to transnational governance. These approaches contend that objects do not possess „objective essence" but rather are "crafted", and "assembled as part of a (individual) hinterland"

(Law 2004, 54). With regard to the analysis of energy controversies as the constituent parts of energy governance our understanding of reality is thus altered: "we are not dealing with different and possibly flawed perspectives on one consistent object. Rather we are dealing with different objects, produced – or for that matter: 'enacted' - in different method assemblages" (Law 2004, 55). I want to introduce a long quote by Annemarie Mol to illustrate this point more clearly (Mol 1999, 75-77, emphases in the original):

> "[The world is] not plural: [it is] multiple. A clarification is required here, a differentiation. For ontological politics is informed by, but does not directly follow from or coexist with either perspectivalism or constructivism. Its pivotal term is slightly different: it is performance.
> *Perspectivalism*. As against the singularity of the single truth voiced by the anonymous, objective 'expert', it has been argued that there are *many experts* with different professional and social backgrounds, or indeed with no specific *professional* background at all: the word 'lay expert' was invented. And since each of these experts is a different person and comes on the scene from somewhere different, none of them is objective. They are instead specific social subjects, each. They bring with them their own particular skills, habits, histories, preoccupations which means that their eyes are different. They look at the world from different standpoints. This means that they see things differently and represent what they have seen in a diversity of ways. Much of the subsequent discussion has turned around the question of how this diversity must – or might – be valued.
> Perspectivalism broke away from a monopolistic version of truth. But it didn't multiply *reality*. It multiplied the eyes of the beholders. It turned each pair of eyes looking from its own perspective into an alternative to other eyes. And this in turn brought *pluralism* in its wake. For there they are: mutually exclusive perspectives, discrete, existing side by side, in a transparent space. While in the centre the object of many gazes and glances remains singular, intangible, untouched.
> A second kind of pluralism took the form of *construction* stories. These show how a specific version of the truth got crafted, what supported it, what was against it, and how its likely alternatives got discredited. Many stories about the support facts-to-be and artefacts-being-shaped require, in order to survive, to tell about relevant groups of researchers and/or others who are involved (and here constructivism links up with perspectivalism). But in other constructivist stories material rather than social support is foregrounded: the lenses in which the wave theory of light is made durable, or the dissection room with its knives and skills that anchor the fact that diseases carve structural changes in the body.
> The sting of construction stories is that the alternatives for any currently accepted fact or well diffused artefact were not doomed to lose from the beginning. They got lost somewhere along the way, as a matter of contingency. We might have had another kind of bicycle, keyboard or video system. It just happens that we've come to stick with the one's we've got. And with facts it's the same. The secret of their success lies not in the law of nature but in the intricacies of history. Thus constructivist stories suggest that alternative 'constructions of reality' might have been possible. They have been possible in the past, but vanished before they ever fully blossomed. So there is *plurality* again. But this time it is a plurality projected back into the past. There have been might-have beens, but now they have gone. The losers have lost.
> Talking about reality as multiple depends on another set of metaphors. Not those of perspectives and construction, but rather those of intervention and performance. These suggest a reality that is *done* and *enacted* rather than observed. Rather than being seen by a

> diversity of watching eyes while itself remaining untouched in the centre, reality is manipulated by means of various tools in the course of a diversity of practices. Here it is being cut into with a scalpel; there it is being bombarded with ultrasound; and somewhere else, a little further along the way, it is being put on a scale in order to be weighed. But as a part of such different activities, the object in question varies from one stage to the next. Here it is a fleshy object, there one that is thick and opaque and in the next place it is heavy. In performance stories fleshiness, opacity and weight are not attributes of a single object with an essence that hides. Nor is it the role of tools to lay them bare as if they were so many aspects of a single reality. Instead of attributes or *aspects*, they are different *versions* of the object, versions that the tools help to enact. They are different and yet related objects. They are multiple forms of reality. Itself."

The evocative phrasing of Mol dismantles the idealistic portrayal of objects as well as infrastructure as "material and utterly fixed assemblage of hard technologies embedded stably in place, and which [are] characterized by perfect order, completeness, immanence, and internal homogeneity" (Graham 2010b, 8). The production of objects within different actor-networks is in fact regarded as constantly and endlessly permuting, thus adding an active mode to the notion of transnational energy governance (Mol 1999, 75). Objects never reach a state of fixed and given identity (Law 2004, 55). Atomic waste, shale gas, transnational oil and gas pipelines, dams, wind parks and solar installations" in various regions are conceptually the same but practically different constitutive pieces for the enactment of larger energy landscapes and energy governance arrangements in different social and political situations. Nor does there exist a true or false enactment of an infrastructure. All enactments are real. In that sense *enacting* infrastructures must be understood as a continuous *staging* and *restaging* of particular sociotechnical arrangements in particular spatiotemporal conditions (Law 2004, 56). Their *identity* is a different one for each event they are part of. Talking about enactment thus always encompasses talking about 'object performances' or objects 'in-the-making'. The fact that they "can be combined and deployed in relation to countless other elements, gestures, practices and institutions" leads them to "carry a margin of indeterminacy" (Braun and Whatmore 2010: xxi). Technical artifacts are thus inappropriately conceptualized when portrayed as *deterministic*.

**Spaces of transnational governance arrangements**

In this context of *joint enactment* of technical infrastructures the direction in which the governance of an infrastructure project goes depends on the negotiation and (temporary) settlement of different possible enactments among all the involved participants. The precise

geographical and relational space of the actor-network that is effectively related to the electricity network under study therefore plays a central analytical role. However, a caveat has to be made with regard to the delimitation of such a space. Indeed, due to the fast changing nature of electricity systems, these geographical and relational boundaries are not stable, but always in flux (Callon, et al. 2001, 30, Barry 2006, 239).

The concept of a *technological zone*, coined by Andrew Barry and informed by actor-network theory, sheds further light on the importance of this last argument (2001, 2006). Thus, the concept of a technological zone is grounded in a differentiated analytical approach towards issues of liberalization and internationalization or what Amin has called the "trans-territorial production of space" (Amin 2000: 671, cited in Barry 2006: 239). Thus, a *technological zone* is defined as "a space within which differences between technical practices, procedures and forms have been reduced, or common standards have been established" (Barry 2006, 239). In other words, a 'technological zone' refers to a space in which both technical infrastructures and political decision-makers and other relevant actors are being *assembled* during the attempt of regulating the issue at stake (e.g. energy availability, reliability, trade etc.). Thus, the creation of a technological zone is regarded as arising out of the progressive expansion of technical systems and their intertwining with (transnational) political decision-making. It is important to note, however, that the demarcation of the technological zone does not correspond to the logic of the administrative boundaries of nation-states. Rather, its limits cut across these boundaries, thus encompassing some territorial spaces in their entirety and some others only in part. Furthermore, due to the complexity of technical infrastructure systems as well as due to the fluctuating inclusion of a wide variety of relevant actors and interests (from political decision-making, civil society, engineering etc.) the limits of technological zones are not stable but are regarded as essentially contested and uncertain (Barry 2006, 239). Nevertheless, these momentary fixations of meaning form a part of the contested road to a potential mutual agreement and they may eventually be stabilized in energy governance arrangements if the material artifacts that are also engaged in the process *play along*. In the words of Graham and Marvin "the emergence of a certain political agenda or not can be regarded as the result of the joint performance of individual human and nonhuman actors who converge towards a certain *molding* of distributional justice and planning power" (Marvin and Graham 2001, 12, emphasis added). The usefulness of the concept of a *technological zone* thus lies in providing us with an analytical tool, that allows us to

explore alternative forms of "political organization [that exist] outside the logic of state-oriented politics" (Ashley 1996, 245).

**Interim conclusion**

The present chapter has presented a perspective on transnational energy governance that is informed by new scholarship in the field of Geography, Critical Infrastructures and the Built Environment. The unifying factor of the chapter has been Latour's *sociology of associations* or *actor-network theory* (Latour 2005) that has allowed me to bring the territorial and spatial situatedness of transnational energy governance to the fore by going more in-depth on the role of *objects* and specifically *technical objects* in transnational energy governance. To recapitulate, the importance of the arguments made in the present subchapter are as follows:

(1) In the first place, the analytical lens provided by the sociology of associations offers the possibility to theorize the simultaneous co-evolution of humans and things in ongoing re-configurations of transnational energy landscapes. The key insight with regard to the intrinsic relationship between humans and things and thus by implication between the social and the technical is that electricity breakdowns or disasters do not *precede* standardization and regulation. Instead they are *intertwined* with it. Technical innovations spring from social practices just as well as they give these social practices their characteristic form. The difference of this 'constructivist' (Mol 2003, Latour 2005) perspective vis-à-vis the 'social-constructivist' perspective (Giddens 1984, Wendt 1987) is its emphasis on the "*movement of assembling of non-social entities*" into a hybrid collective with agential capacities (Latour 2005, 88). This sets it apart from a social-constructivist perspective that assumes that only humans are agents and that there is some kind of "social stuff" (Latour 2005, 88) that we can define as the (more or less) stable structures around them who provide the basis for agency (c.f. Verbong and Loorbach 2012, 9). What I find particularly useful in this 'constructivist' perspective on transnational energy governance is that selecting a technical utility as a starting point for the research of transnational energy governance facilitates the analytical tracing of the heterogeneous and complex relations between humans and nonhumans sketched out so far. By focusing only on strong relational connections that spring from the technical infrastructure at hand I am able to trace relatively extended spatiotemporal assemblages without losing the focus for those relations that really

matter in the transnational governance of electricity. In this regard, the usage of the word 'technology' is of relevance.

In other words, I thus follow the understanding that a technology is not a neutral element in our everyday lives but an "assemblage of heterogeneous elements linking the technê with procedures, regulations, institutions, discourses, perceptions and attitudes" (Deleuze 1989, Foucault 1995). This usage is consistent with the lexicographic usage of the term as "the practical application of knowledge especially in a particular area" (Merriam Webster Online Dictionary 2012) but it provides a deepening and consolidation of our common-sense understanding of which actors and objects become related through a technical device stemming from a particular area (in this case electricity), how they are related, and by mapping out which major dynamics emerge between them.

(2) Second, by bringing in the notion of co-evolution of humans and nonhumans - and by implication the co-production of transnational energy governance between these heterogeneous elements - the presented arguments from the field of New Geography, Critical Infrastructures and the Built Environment highlight how hybrid collectives including humans and nonhumans form around different technical devices; such as e.g. the electricity grid or a new renewable power plant. Being in charge of officially and authoritatively settling the disputes that arise within sociotechnical collectives political decision-makers need to engage. It is important to note that in the perspective that I will follow-up here, however, the political decision-makers are not external to the emergence of new governance arrangements. They form part of it. Also it is important to note that technical objects may actively intervene in this negotiation of controversies by themselves, as they possess the power to reorder the constellations of the involved actors (human and nonhuman), their relations and the dynamics that emerge between them.

(3) Third, I shall argue that foregrounding technical objects as the mediators of practices and thus social and political communities is essential if we are to take the turn towards a local-global continuum as the basic unit of analysis seriously. I therefore contend that considering situated technical objects as the *mediators* of local and global policies is key to explicitly appreciate how local circumstances and situations come to intervene in the transnational governance of energy.

(4) Fourth, it is by following up on these circumscribed spatial and temporal connotations that we can try to get a grasp of how old and new actors engage in the production of new transnational governance arrangements. What counts is the spatially and temporally contingent link to the technical infrastructure at hand, "the local and lived interaction" with it (Latour 2005, 169), and not the formal affiliation with a distant organization. In this context, "location, proximity and distance are relationally rather than geographically determined" (Amin and Roberts 2008, 365). Put succinctly, it is most promising to approach the transnational governance of electricity via the entry point of technical objects. In this way it is possible to trace the *actual* parties or entities that are concerned by an infrastructure and therefore will most likely make a difference in its materialization, operation and regulation.

## 4. Theoretical synthesis

In the previous two chapters I have presented two disciplinary approaches and their perspective on the study of transnational energy governance. In this chapter I shall integrate the discussed arguments from IR and from Critical Infrastructures in a unified theoretical framework that is also suitable for my empirical analysis. The aim of the synthesis presented in this chapter is to highlight interfaces and discrepancies between the statements that each body of literature puts forward and to point at those spots where ANT is able to provide a corrective for analytical lacunae. Most importantly this synthesis shall provide an important building bridge from the existing literature towards a new theorization of critical infrastructures in transnational energy governance. For clarity reasons I will again follow the sixfold structure introduced in the discussion of Susan Strange's (chapter 2) approach to present my synthesized statements and enlarge the six discussed points on technical objects, controversies and sites (critical infrastructures, chapter three). This discussion will allow me to hone my alternative argument to technical infrastructure regulation in transnational energy governance. The discussed points were:

(1) the role of the state;
(2) the relationship between the state and the "international" system;
(3) the criticism of rationality assumptions;
(4) the relevance of the empirical case;
(5) the notions of stability and change;
(6) technical devices, controversies and sites of technology[25];

The present chapter shall build a bridge to the case study and close with a list of empirical questions that will help me to tackle a first content analysis on the topic of blackouts.

[25] For major clarity and argumentative substance, I tackle the issues of technical artifacts, controversies and sites of technology in one section instead of two different sections, which would probably lead to logical confusion.

**The role of the state**

At the early stages of the discipline of IR scholars were mainly interested in studying the relationship between *states*. [26] This holds true for Realism as well as for Liberalism and also for International Regime Theory as I have discussed it in chapter 2. In these perspectives, the national government is the competent and legitimate authority for the regulation of international politics - that is the 'affairs of the inter-national community' (drawing on Aristotle's definition of "ta politika" as "affairs of state"; Aristotle and Richard Congreve 1855). As a consequence, the power to analyze issues, devise strategies and ultimately policies lays firmly in the hand of a relatively circumscribed group of statesmen who appear as outside observers and perspicacious intellectuals with the capacity to steer the nation's fate in the international system and thus act as a unitary actor on the international arena. By advancing their hypothesis of interdependence in world politics scholars as Robert O. Keohane, Joseph S. Nye or Stephen Krasner (Keohane and Nye 1977, Krasner 1983) lay the foundation for IR to cover the necessity of inter-state cooperation and transnational governance thereby expanding significantly the geographical scope of governmental ordinances. However, neither interdependence nor regime scholars address the question whether other actors that are not explicitly part of the state can also be able to deploy political power in the international arena.

The rise of the subdiscipline labeled 'International Political Economy' (important works encompass e.g. Ruggie 1993, Risse 1995, Cutler 1999, Cutler, et al. 1999, Porter 2002) and specifically the works of Susan Strange that I discussed more in-depth in chapter 2 (Strange 1982, 1986, 1991, 1994a, 1994b, 1996) questioned the importance of the state as the sole legitimate authority to regulate questions regarding the "affairs of the inter-national community" (Aristotle and Richard Congreve 1855). Authors that argue from this perspective recall the *social* construction of national governments and the state by man, and point at the importance of taking into account all the sources that *influence* humans in this process. In short, authors arguing from an IPE perspective hold that the state or the national government are ill conceived if regarded as the natural and sole authority in political affairs.

As a corrective they recommend to acknowledge the importance of scrutinizing state-society interactions as a means to actually determine the social *foundations* of state politics, or, put in

[26] Though relations between countries have been studied in Ancient History as well (Egypt, Greece, Roman Empire), I here refer to the foundations of International Relations in the 20th Century only.

terms of the agency-structure debate in IR (Giddens 1984, Wendt 1987, 1994): the human creators of institutional structures. The differentiation between human agents and formal structures allows for a decentering from the traditional (state) unit of analysis of IR that now comes to interact with other dimensions of society, such as the economy, trade, law etc.[27]. In an attempt to provide a *limited* generalization of this *social-constructivist* finding, Susan Strange formulates her assumption of the four main and four secondary power structures in the world economy: security, production, financial, and knowledge structures and transport, trade, energy and welfare (1994a). She opposes those structures to three primary actors or anthropocentric forces that are able to configure and play out those structures in the world economy: i.e. states, markets and technologies (Strange 1991, 39). While this step proves historically important for the theorization of international politics in the sense that it allows us to appreciate that public policy and social life are not separate but hang together, the conceptualization provided by Strange also generates new demarcations and thereby new problems of assigning a specific actor or issue its place within one of those structures or agential forces. What seemed initially a straightforward frame of analysis provided by the structuring concepts of agency and structure is thwarted in Strange's attempt to create generalizable categories. The scope of political analysis is broadened but the analytical model suffers from the same static as the state-centric model of analysis. Practice theory provides a more appropriate solution.

They were the first in the discipline of IR who tried to avoid the agency-structure demarcation introduced by Giddens (1984) and then Wendt (1987) by switching to Etienne Wenger and Theodore Schatzki's 'practices' (Schatzki 1987, Schatzki 1997, Wenger 1998, Schatzki, et al. 2001) as the smallest unit of analysis. Based on the IPE scholars' critical analysis of the *constitutive components* of 'the state' or 'the government' they analyzed more in-depth how dehumanized structures impacted on societal relations and inter-state politics the question turned towards *how* the state and ultimately the realm of what is political is actually *constructed*. Similar in their intent to decenter the state from IR political analysis, IPE and Practice Theory provide two fundamentally different explanations of the world. For the early IPE scholars[28] the reliance on structuration theory (Giddens 1984) was an analytical tool to investigate the internal

[27] These dimensions of world politics are still socially constructed collectives but I use them here to point at the iterative diversification of the study of international politics towards other subfields different from the state and state security (i.e. military and geopolitical considerations).

[28] IPE is a broad field of study and encompasses many contributions. When I refer to IPE I strictly refer to the contributions reviewed in chapter 2.

social components of state politics and the interlinkages between them. For practice theory however, this framing of the question remains too static. Practice scholars consider that a state does not merely consist in the dehumanized structures constructed and codified by human actors over time but is significantly shaped by the *daily* practices that unfold among those actors. It is these practices and their routinized repetitions that form the basis of a sustainable construction of social collectives and thus macro-structures over time.

The state is thus hybrid not only in the sense that IPE scholars conceive it, that is, as a compound of political *and* social (market and society) forces, but additionally it is hybrid in the sense that it includes practices that involve agents and structures, humans and nonhumans simultaneously. In short, practice theory stresses the importance of interactions actors and macro-structures play a modulating role for these interactions. Due to this intrinsic intertwinement, it is analytically improper to distinguish agency (that depends on structures) from structures (that depend on agency). With regard to the importance of material or ideational structures however I argue that practice theory does not address the role of such material and ideational objects in the way that I find the most productive, i.e. as a kind of 'dark matter'[29] (Latour 2005) that deploys an impact on state politics.

In practice theory objects are merely theorized when they *explicitly* contribute to the actions or ideas of human agents, that is, as instruments. However, I want to argue here that there are manifold ways in which inanimate matter can influence state practices without humans having *expressly* planned for it. Purposeful action is thus not yet sufficiently put into perspective by practice theorists. My strategy is thus to follow up on the *structuring* power of technical objects for the constitution of transnational politics as I have foreshadowed it in the chapter of the New Geographies and Critical Infrastructures literature. My approach integrates the suggestion of the presented approaches that the state is not the sole authority in transnational governance and elaborates an impartial an unprejudiced perspective on how entities from the social, the political and the technical intertwine in the constitution of transnational energy policy. Rather than postulating that there exist other forces beyond the national government and determining them *a-priori* I thus ask:

[29] „Dark matter" is a technical term from the field of astronomy. It denotes „a component of the universe whose presence is discerned from its gravitational attraction rather than its luminosity. […] Originally known as the "missing mass," dark matter's existence was first inferred by Swiss American astronomer Fritz Zwicky, who in 1933 discovered that the mass of all the stars in the Coma cluster of galaxies provided only about 1 percent of the mass needed to keep the galaxies from escaping the cluster's gravitational pull" (Encyclopaedia Britannica Inc. 2012).

- ***What are the individual entities that are involved in the transnational governance of electricity?***

As regards the role of the *state* as a structuring concept of IR this means that its substance is altered to that effect that the state does not exist *naturally* but is regarded as formed and forged in the interplay of heterogeneous humans and things. States as well as other administrative governance structures above or below that level of aggregation are assemblages of material, immatieral, and human objects. To investigate state policy in a particular realm, as e.g. electricity, one must thus pay attention to the individual components that iteratively piece it together.

**The relationship between the state and the international system**

Under the previous heading, I have argued how problematic it is to take the state as a natural entity and formulated a first generic question that asks about the plethora of heterogeneous components of the concept of the 'state'. In this subchapter, my ambition is similar but reversed. After having asked what distinguishes the state as a political entity towards the *inside* (.i.e. domestic population social and technical forces) I ask here how the nation-state is actually different from its international *environment*, that is, other states and the international system.

In International Regime Theory the analytical interest of scholars lies primarily on how unitary states interact with each other in the international system and how they may produce binding norms and regulation for their interplay (Krasner 1983). In this perspective it is established from the outset that the international system is the common context of many separate units who act like billiard balls on a pool table. Reiterating the above-stated argument that there exist no naturally social compounds with regard to state politics, I infer that we also cannot talk of any natural social collective with regard to the international system. Rather it is necessary to trace the entities that piece together the international system as well.

Analogous to my critique that we cannot delimit state politics on the basis of accumulating a priori defined social aggregates as the government, the market or technology as early contributions from IPE do (Strange 1994a), I suggest here that we cannot delimit the international system as the sum of all the nation-states contained in it.

For this problem as well, practice theory provides a limited corrective. It provides the tools to explicitly theorize the coexistence and overlap of different practices that together participate in forming particular governance patterns and arrangements (Adler and Greve 2009).

The international system can hence be used as a metaphor for what goes on beyond the boundaries of the nation-states but the same concept cannot be filled with substance by relying on the accumulation of mutually exclusive state units only. Analogous to the discussion of the social, technical and political elements that together come to forge what may be termed as "states" or "state regulation" we must take into account that the dominance over territories or issues may be shared or at least disputed different entities advance concurring claims towards them. Different entities may form part of it and these entities may or may not be in contradiction with each other. In international law concepts as derogative legislation have been coined, which denote the precedence of one set of regulations over another set of regulations. However, it is clear from a legal perspective that derogative powers require situated interpretation, that is, situated as regards a particular concern. Otherwise regulative vacua would be the consequence. With regard to the topic of transnational electricity governance the following question arises:

- ***On what basis can we designate the situatedness of entities to be local or global?***

The relevance of this question consists in positing once again that social collectives cannot be assumed to exist a priori on the international level either (Latour 2005). All that exists are "movements of association" (Van Wezemael 2008a) between entities of different kinds: material and immaterial things, and humans. The definition whether a thing or an issue is local or global then depends on the kind of its relational embeddedness, that is, on its capacity to ideationally or territorially affect circumscribed geographical zones.

**Rationality and intentionality**

In International Regime Theory scholars attribute the rise of regulative arrangements among states to the appearance of transnational issues that require the strategic cooperation of all the affected governmental authorities. In this perspective, agency is structured along human reason and strategic human decisions with regard to a desired end. Be it the cost-based strategies (logic of consequences) that states pursue when they agree to participate in a regime or the norms and

discourse-based strategies for action (logic of appropriateness or deliberation), once human actors have become members of a regime, all are formulated on the basis of what humans rationally think could be the most effective strategy to match the available means with their desired ends – if not in one pour than at least following a cumulative process logic that entails successive amendments to established strategies or regulations.

In the perspective of political economist Susan Strange, this kind of purposefulness of human actors is an ideal that can impossibly correspond to reality. She advances that means match ends only in hindsight and as a result of psychological *rationalizations* by humans (Strange 1976a, 1976b). She therefore directs her attention to the specific historical and political circumstances in which decisions develop. Her critique of human purposefulness however covers only one side of the coin, that is, the changeability of the human *mind* in the face of specific historical and political situations (Strange 1996, 21). Strange argues that, since agency of human actors does not emerge in vacuo, alternative actors and situations always possess the capacity to influence the construction of the human will and coinciding strategies time and again (Strange 1991, 34). To account for this, Strange introduces the concept of non-linear development paths in international political decision-making. However, she leaves the question of how inanimate matter, that is, immaterial and material things, might intervene and affect development paths entirely aside. In this respect, practice theory provides a more encompassing analytical perspective as it conceptualizes international political decision-making as being grounded not in conflicting human intentions only in heterogeneous practices that include both humans *and* things.

Practice theorists assume that practices of different groupings may coexist and potentially overlap and look for acausal-analytical explanation of *how* the standardization of one set of practices takes precedence over another set of practices (Adler and Greve 2009). They find their answer by analyzing the interactions that exist between distinct sets of practices and by highlighting that *novel* practices arise from the continuous interplay and successive adjustment of different sets of practices. What is relevant for the analysis of transnational energy governance is that by relying on a theoretical perspective that understands heterogeneous practices to be at the root of transnational governance there may never be one single cause or origin for a specific governance arrangement or regulation. Rather is the responsibility for such a governance arrangement to be considered as shared between heterogeneous actors and practices who only in their peculiar constellation make decision-making possible. Political decision-making is thus

regarded as an iterative process within which different social subsystems interact and negotiate with each other until a generally accepted overarching system gains dominance. Here I build on this conceptualization while also drawing on the expanded conceptualizations of the "New Geographies" perspectives to explain the irrationality and non-linearity of this process of governance moulding. In this perspective such processes of transition from one or more constellations of actors to a new one, such as for example the transition from national state regulation to transnational governance, "we are faced with a situation where innovations proliferate, where group boundaries are uncertain, when the range of entities to be taken into account fluctuates, [and] the sociology of the social is no longer able to trace actors' new associations" (Latour 2005, 11). It is a process of change that can be more appropriately described as *rhizomatic* (Deleuze and Guattari 1987) than as evolving linearly from an imagined point A to another point B. The central idea of rhizomatic change as opposed to linear change is that a *twist* or radical change in the overall constellation of actors can offshoot from any single *center of agency* or practice that constitutes it. Independently of hierarchical or chronological orderings (Deleuze and Guattari 1987). The New Geographies literature thus assumes a conglomerate of human and nonhuman actors who within each of the nodes of a rhizome. These human and nonhuman actors are able to spur change in transnational governance processes depending on their immediate interlinkages within the assemblage. Additionally, this literature takes into account the independent logics and requirements of technical systems as well, which may additionally affect and undermine the development of governance alternatives.

It becomes thus visible from such an argument of rhizomatic change and nonlinearity that human rationality (that is: ways of structuring agency in *cumulative* steps) may never be realized ad hoc but may only emerge *a posteriori* (Pouliot 2008). Put differently, the logic of practicality is *ontologically* prior to the logic of rationality, and also prior to the logic of appropriateness or deliberation because the latter are not "a priori inscribed in human beings' minds but historically constituted in habitus and fields" (Pouliot 2008, 276, 277). The question that arises in this context where every development is unstable and reversible at least in principle (Law and Hassard 1999, 4) is the following:

- ***What are the sources of the reorganization of transnational electricity governance?***

**Relevance of empirical case**

In the perspective of International Regime scholars, the empirical case provides the opportunity to test and falsify hypotheses regarding the process of inter-state cooperation in the international system. In the light of Regime scholars' interest to determine how states may reach consensus on the compliance with behavioral guidelines in the international system they use the empirical case serves merely as an illustration for the axiomatic state interests and ultimately as a support for theoretical generalizations on the behavior of states. The concrete issues and interests may differ between empirical cases but the main motives for cooperation (power, transaction costs etc.) remain the same.

International Political Economists and specifically Strange later argued that not only would cases illustrate generalized theoretical hypotheses but that instead the close scrutiny of small-scale interplays provide theoretical generalizations with their empirical substance. In her theoretical perspective theoretical generalizations need to be anchored (bottom-up thinking) and not merely falsified (top-down thinking) by being tested on concrete empirical cases. As a consequence, only limited generalizations are possible, that is, with regard to a limited field of action. This is because Strange postulates that the concrete processes of social interactions among politically relevant entities differ between one peculiar historical or otherwise contextual situation (sectors and territories) and another. Even slight variation is meaningful and provides the sought theoretical explanation with added value.

However, and despite her interest in laying bare the precise trajectory of political decision-making in world politics, Strange only provides initial scaffolding to the questioning of larger scale generalization: she continues to hold that there exist a handful of *a priori* relevant collective actors within empirical cases, such as states, markets and technology (1991), and asserts we can make general statements on how their field of influence is constructed. Her call to impartiality thus stops at the boundaries of some basic units of IR. Shifting the focus of attention to practices offers a corrective here in that the existence of *pre-defined collectives* is more consistently deconstructed.

It is more effective to account for the many facets of world politics by choosing a theoretical perspective that explains world politics on the basis of 'a [continuously sustained] doing on the world' (Adler and Pouliot 2011, 2, empasis added). In this way, shifting alliances between individual entities can be observed more easily. But according to my interpretation even some practice theorists in IR fall into the trap of *social-constructivist* theorizing (Latour 2005, 88) by *a*

*priori* assuming a connection between everyday practices and their anchorage in some specific areas of practice performances as e.g. "power and security, trade and finance, strategy" (Adler and Pouliot 2011, 2).

Here is why I consider that selecting a theoretical perspective that takes 'visible matter' in the form of a *material* technical object as an entry point to an empirical case performs better with regard to tracing the singularities and contingencies of a particular empirical case. With the emphasis on practices and 'lived interactions' (Latour 2005, 169) the impartiality of our analytical perspective is maintained. Indeed, an object is only chosen as an entry point to the empirical case in the public debate revolves around it, that is, if various participants in the debate discord over the object's interpretation and eventually the potential solutions of the discord. Otherwise, there would be no point in analyzing the actor-network in which the object is embedded. The often reiterated dualism between agency and structure, micro and macro, inside and outside, social and political is hence deconstructed in a thorough and productive way because a material object is always embedded in an actor-network that contains all of them. Political agency is always dependent on performances among humans and things, and especially on the way in which they actually evolve and on the critical analysis of whether the specific interaction we witness is of political relevance or not. Entering the empirical case on the basis of a material entry point intrinsically forces us to follow up and think through the interconnections that actually exist between nonhuman and human entities and that are not *per se* social or political in kind (Barry 2009). The question that arises with regard to the importance of the empirical case in transnational governance of energy is thus:

- ***How do movements of association between human and nonhuman entities unfold in transnational energy governance?***

**Stability and change**

I have argued before that from the perspective of International Regime Theory, stability in international relations is fostered via the signing of binding agreements between states. In consideration of the fact that states have conflicting national interests but that nevertheless states can affect each other by reason of the issue-related interdependencies that exist between them, regime scholars posit that the drafting of multilateral agreements foster trust in the international

arena by regularizing behavior and thereby supporting a relative certainty of expectations. Regime scholars posit that state behavior is in principle characterized by volatility of interests and that stability in world politics is achieved via the construction of formal institutions that reduce transaction costs and facilitate cooperation. According to this perspective behavior is difficult to change once a binding agreement has been instantiated because in the absence of a more promising and desirable agreement the signing parties shall always prefer to stick to the existing agreement as the least common denominator that exists between them. Change shall thus merely be caused by external shocks as e.g. natural hazards or unexpected changes in a part of the world system that is not part of the formulated agreement. I have outlined before that Susan Strange offers a corrective to this perspective by challenging the assumption that formal agreements between states can be equated with their actual behavior in the international arena (Strange 1982, 489). Agreements do not guide the behavior of states, they merely establish the lowest common denominator for behavior in the international arena. Beyond that common denominator states are free to act differently as long as their behavior does not interfere with what has been defined in the agreement. This reality proves that stability is not an enduring characteristic of world politics but one that requires considerable and repeated effort by all participants to be sustained over time. Articles of agreements need to be implemented by the signing parties every day afresh. Thus every slight variation in their implementation eludes the forecast of stability in world politics (Strange 1994a, 231). As a logical consequence, change is not only induced from the outside but is intrinsic to any binding agreement.

Practice theory goes a little more in-depth with this interpretation of world politics. I have highlighted earlier that, from this perspective world politics is regarded as constituted in heterogeneous practices including "agents *and* structures, ideas *and* matter, rationality *and* practicality, and stability *and* change (Adler and Pouliot 2011, 4, emphases added). Because the focus of practice theory is less on the diverse actors that shape a certain area of world politics and more on their interaction in specific practices it is acknowledged that stability cannot be inferred on the basis of agreements between parties only. Agreements may certainly provide the intersubjective framework for repeated performance of specific practices in a group but according to practice theorists its variability and flux that are the norm in world politics and stability can merely be ascertained ex post. Thus, repetition can thus be found in world politics but variation is the norm within this iterative conceptualization of agency.

The approaches presented under the heading of New Geographies accentuate this iterative and in the end non-linear aspect of social processes even further. From these approaches, inanimate matter and humans co-evolve in a process that is characterized by the profound *intertwinement* of humans and things and not merely the mutual *dependency* of these. The difference between this conceptualization and the one advanced by practice theory is noticeable when we make the differentiation that material objects not only *support* social practices among humans but also give them their *distinguishing* traits. Taking the example of transnational governance of energy, cross-country trade of *electricity* would be unthinkable without the involvement of high voltage transmission lines and converter stations to facilitate trade despite differing frequencies that exist in participating countries (informed e.g. by Barry 2010). On the other hand, the international trade of *oil* and *gas* requires either long-distance pipelines or apposite cargo ships that in turn go along with specific practices of merchandise unloading. In other words, the trading of specific kinds of energy supplies is not only dependent on the social practices alone but entails also particular logics depending on technical materials, technical infrastructures and associated practices (Barry 2013, *forthcoming*). The question that arises in this context is thus how do technical objects intrinsically affect stability and change in international politics, or:

- ***How does a technical object reconfigure centers of agency in transnational energy governance? Which entities and relations become foregrounded?***
- ***What are expected and what are unexpected reconfigurations of entities relations between human and nonhuman entities?***

The relevance of such questions for the study of transnational energy governance resides in the appraisal that technical breakdowns do not *precede* political standardization but are instead *intertwined* with it. Stability and change depend on the kinds of movement of assemblage that unfold among humans and nonhumans. I shall thus argue that change happens when a technical entity disturbs the existing process of co-evolution among humans and nonhumans by forcing thought on and negotiation of alternative evolutionary processes and thus re-organizes the roles of the involved entities.

**Technical devices, controversies and sites of technology**[30]

Answering the previous question on how technical artifacts contribute to the reorganization of agency calls for a critical examination of the concepts of 'technical artifacts' and their relation to the broader concept of 'technology'. As the title of this subsection foreshadows I advance an intrinsic understanding of *technical devices* – which are also understood as *têchne* (Deleuze 1989, Foucault 1995) - and *technology* and suggest that the relation between the two shall be regarded as based and instantiated by the carrying out of controversies around technical artifacts and the resulting practical applications, i.e. practices of these in particular sites of technology, such as the aforementioned cross-country trade of electricity or other energy sources.

The perspective I put forward in this thesis is thus very different from the one put forth by International Regime Scholars and even critical political economists as Susan Strange in that I argue that technical devices are at the core of transnational energy governance because they actively contribute to the structuring of transnational energy settings. On the other hand, the perspectives of International Regime Theory and IPE postulate that technologies, that is, technical devices (including the instructions for use in practical situations) are developed by *technical engineers* who live a dismal existence *beyond* society and politics and then diffuse their products by selling technologies to the markets. Seen like this international politics constitutes an external environment in which political decision-makers respond to technological innovations by trying to regulate them ex post (Ruggie 1975, Strange 1991, 38).

I have to concede that the conceptualization provided by Strange presents a development of the initial instrumentality argument put forth by International Regime theorists because it constitutes an attempt to foreground the importance of technology in political decision-making. However, I find that Strange does not address the *intrinsic* relationship that exists between technological innovation and social and political modes of interaction. She states explicitly that nation states, markets and technologies are three distinct and mutually exclusive agential forces that precede sectoral or otherwise specific power structures as well as corresponding regulations or control mechanisms (Strange 1991, 38-39). In this conceptualization, governance remains simply the politically authoritative way of *acting upon things* from the outside. The intrinsic nexus between governance and the sociotechnical reality on which and within which political decision-makers govern is not addressed. Practice theory provides a useful corrective by advancing a new

[30] For major clarity and consistency, I tackle the related issues of technical artifacts, controversies and sites of technology in one section instead of different sections, which would probably lead to logical confusion.

understanding of governance that is grounded in an understanding of acting *with* things. However, I expand a little further and draw on the perspective advanced by the New Geographies literature when I argue that we additionally need to make a further step ahead and explore *how* technical objects participate in group formation. I argue that it is not human-oriented practices that serve as an organizing principle of transnational energy governance. Instead we should direct our attention on the objects that influence social and political practices among heterogeneous actors. The concept of the 'technological zone' coined by Andrew Barry (Barry 2006) is grounded in such an object-oriented analytical approach toward the above formulated question of how technical objects re-configure centers of agency in world politics.

In the words of Andrew Barry a technological zone is " a space within which differences between technical practices, procedures and forms have been reduced, or common standards have been established" (Barry 2006, 239). Put differently, a technological zone analytically grasps that space in which technical components, political decision-makers and other relevant human anctors are being dynamically *assembled* in the *undertaking* of regulating an internationalizing issue.

In the realm of energy governance the formation of a technological zone takes place around the regulation of energy production from particular sources or around the transmission and distribution of electricity via technically specific transmission lines as e.g. optic fiber. As new technologies arise, they trigger controversies among the already involved and newly affected groups as to how they could or should be put to use. Different "communities of practice" (Wenger 1998, 2000) form around different or identical technical artifacts and who all develop a situated kind of usage around it. As these communities of practice expand across the territorial and administrative boundaries, overlaps and thus zones of friction emerge. The creation of a technological zone thus refers to the progressive expansion of technical systems careless of territorial and administrative boundaries and – especially – out of the need to *standardize* and then *regulate* them across different territorial spaces. The forging of a technological zone is a dynamic and continuous process that intrinsically includes all the aspects of world politics that International Regime Theory and political economy conceptualize as mutually exclusive: states, markets and technologies. Barry provides the theoretical tools for an integrated analysis of states, markets, societies and technologies without relying on the social blackboxes that these concepts provide. On the basis of an object-oriented conceptualization of technological innovation processes Barry presents the possibility for an unbiased and inclusive definition of those actors,

interests, issues and material conditions that may impact on the formation of a technological zone while at the same time allowing for sufficient flexibility to account for change and innovation. Indeed, the centering of this argument around material objects and the inevitable controversies that arise around different interpretations of usage and regulation contain the seeds for a fluid conceptualization of the spaces and boundaries of transnational energy governance (c.f. Barry 2006, 239).

On the basis of this elucidation a tentative answer to the above formulated question of "*How a technical object reconfigures centers of agency in transnational energy governance "* becomes possible: it is by triggering new social and political discourses and by forming part of the new sociotechnical assemblages that structure daily lives and the corresponding sense of boundedness of persons (informed by Barry 2001, 20).

In what follows, I conceptualize transnational energy governance in resemblance to Barry, that is, as a specific form of technology (in the sense of a practical governance application) comprising "forms of knowledge, skill, diagrams, charts, calculations, and energy which make its use possible" (Barry 2001, 9). Hence, I follow a symmetrical approach to humans and nonhumans in the analysis of transnational governance that helps me to inquire into the processes of *how* technical innovations sociotechnical realities and into the implications for the governance of transnational electricity infrastructures.

**Summary of empirical questions**

As a conclusion of this chapter, I formulate the following series of questions that are related to my theoretical synthesis. The questions are listed below for a better overview.

***Q1.*** ***What are the individual entities that are involved in the transnational governance of energy?***

***Q2.*** ***On what basis can we designate the situatedness of entities to be local or global?***

***Q3.*** ***What are the sources of the reorganization of transnational energy regulation?***

***Q4.*** ***How do movements of association between human and nonhuman entities unfold in transnational energy governance?***

**Q5.** ***How does a technical object reconfigure centers of agency in transnational energy governance? Which entities and relations are all of a sudden foregrounded?***

**Q6.** ***What are expected and what are unexpected reconfigurations of entities relations between human and nonhuman entities?***

The next chapter introduces my first empirical analysis of these questions and aims to make the functions of electricity systems and their intrinsic constitutiveness for all the processes of transformation that take place in society and politics more visible (Kaika and Swyngedouw 2000, 120).

## 5. Qualitative content analysis of major blackout events

In the previous chapter I have argued that approaches from the field of critical infrastructure analysis can offer a corrective for some of the limitations of transnational governance theories. I have outlined how material artifacts structure sociotechnical assemblages of humans and nonhumans and how they must not be conceived as a landscape or environment disconnected from society and on which transnational energy governance acts upon.[31] Instead I have suggested that transnational governance is more appropriately conceptualized as an encompassing whole (Deleuze and Guattari 1987) of human and nonhuman entities spanning simultanously the technical, the social and the political. In chapters two, three and four I have written on the empistemological implications of such a 'wholistic' ontological perspective on agency for the field of study of transnational governance in general. Specifically, I have advanced the assumption elsewhere that utility planning processes are better not approached from the standpoint of the involved decisionmakers but around the (blunt) materiality of the planned energy utility (Crivelli 2012, 94).

In this chapter, I provide a first empirical illustration for my hitherto theoretical argument and highlight how the importance of infrastructure as the "dark matter" (Latour 1991, 1992) of society and politics manifests itself empirically in the transnational governance of electricity. I have performed a content analysis of eight major blackout events that took place in the last 12 years and used them to discuss the list of questions formulated at the end of chapter four (c.f. page 79-80 in this thesis). The properties and conditions of electricity infrastructure during blackout events point a finger at the processes of governance that are in force. The example of electricity blackouts is particularly insightful because technical infrastructures have the tendency to get trivialized in our contemporary social environments (Marvin and Graham 2001, 19-21). Electricity supply is indeed hidden for us as it performs its functions in the subgrades of architectural construction works, in pipes or cables, and electromagnetic waves (Star 1999, 380, Kaika and Swyngedouw 2000, 122). We only notice their intertwinement with our lives when delivery fails (Graham and Thrift 2007).

Several authors have pointed out how the case of a blackout effectively highlights the intertwinement of electricity with modern life and politics (Star 1999, Bialek 2004, Bennett

[31] This argument is though commonly suggested in the field, e.g. in the edited volume by in Verbong and Loorbach (2012: 9). It is also an STS perspective on energy transitions but not one that is based on actor-network theory.

2005, Graham and Thrift 2007, Silvast and Kaplinski 2007a, Hines, et al. 2009, Bennett 2010, D. Nye 2010, Van der Leuten and Lagendijk 2010a, 382, 2010b, Verbong and Loorbach 2012). My own approach to the topic bears resemblance to the one advanced by Jane Bennet who provides a particularly relevant conceptual elucidation of the human-nonhuman intertwinements in her account of the 2003 North-American blackout (Bennett 2005). As a means to open the blackbox of traditional units of analysis in the social sciences, Bennet's article starts off with a detailed listing of hetereogeneous entities that manifest themselves in a blackout event and then discusses how technical disruption travels across actors and sites that are dispersed across the epistemologically defined boundaries of humans, nonhumans and social groupings thus necessarily re-configuring established constellations of governance. For better understanting I quote the passage here (Bennett 2005, 448-449):

> "The electrical grid is a volatile mix of coal, sweat, electromagnetic fields, computer programs, electron streams, profit motives, heat, lifestyles, nuclear fuel, plastic, fantasies of mastery, static, legislation, water, economic theory, wire, and wood—to name just some of the actants. There is always some friction among the parts, but for several days in August 2003, in the United States and Canada, the dissonance was so great that cooperation became impossible. The North American blackout was the end point of a cascade—of voltage collapses, self-protective withdrawals from the grid, and human decisions and omissions. The grid includes various shutdown valves and circuit breakers that disconnect parts from the assemblage whenever they are threatened by excessive heat. Generating plants, for example, shut down just before they are about to go into full excitation and they do the same when the system voltage has become too low to provide power to the generator's own auxiliary equipment, such as fans, coal pulverizers, and pumps. What seems to have happened on August 14 was that several initially unrelated generator withdrawals in Ohio and Michigan caused the electron flow pattern to change over the transmission lines, which led—after a series of events, including a brush fire that burned out a transmission line and several tree-wire encounters—to a successive overloading of other lines and a vortex of "disconnects." One generating plant after another separated from the grid, placing more and more stress on the remaining participants. Within a one-minute period, twenty generators (loaded to 2174 MW) tripped off line along Lake Erie.
>
> Investigators still do not understand why the cascade stopped—on its own— after affecting 50 million people over approximately twenty-four thousand square kilometers and shutting down more than one hundred power plants, including twenty-two nuclear reactors. The U.S.-Canada Task Force report was more confident about how the cascade began, insisting that there were a variety of agential loci. These include electricity, with its internal differentiation into "active" and "reactive" power […]; the power plants, which are understaffed by humans but overprotective in their mechanisms; the wires of transmission lines, which tolerate only so much heat before they refuse to transmit the electron flow; the brush fire in Ohio underneath a transmission line; FirstEnergy and other energy-trading corporations, who, by legal and illegal means, had been milking the grid without maintaining its infrastructure; consumers, whose demand for electricity is encouraged to grow without concern for consequences; and the Federal Energy Regulatory

> Commission, whose Energy Policy Act of 1992 deregulated the grid, separated the generation of electricity from its transmission and distribution, and advanced the privatization of electricity."

By reading her account we can see why disruption in electrical systems cannot just be a concern confined to the interest of technicians and engineers. The tight interlocking of single technical electric devices with other technical, social, and political networks contributes to the literally *far-reaching* character of electricity breakdown. The initial disruption may thus cascade towards other energy sectors (power generation, transmission and distribution); towards commercial, legal and regulatory frameworks, towards training and professional networks (Silvast and Kaplinski 2007b, 8), as well as towards other interconnected network infrastructures, especially transport, telecommunication, waste disposal, drinking water and sewage management, with which it is directly interconnected (Silvast and Kaplinski 2007a, 42) to name only a few. In such far-reaching breakdown events actors, activities, system networks and territorial connotations proliferate. Based on our understanding of governance as who speaks to whom over what and how agreements are stabilized, it is indispensable to explore the entities and relations that indeed contribute to a blackout event and how they disrupt and re-assemble existing relations between humans and things so that we can regulate critical electricity infrastructure more effectively (c.f. Ingold 2000, Van Wezemael 2009, on the advantages of explicit theorizing for research outcomes). Whereas we all posess a basic understanding of which areas of modern life are dependent on reliable electricity supply this knowledge is often sweepengly general in scope and hence still undertheorized in the discipline of IR. Indeed, researchers often rely on composite denominations of infrastructures to explain the cascading of power outages across interconnected infrastructures (failure of converter station, overheating of transmission line etc.).

In this chapter I offer empirical evidence for my theoretical argument that in order to regulate electricity infrastructure effectively it is necessary to know as many of the articulations of human and nonhuman conglomerates. It is on the basis of this knowledge that implications for the re-configuration of transnational electricity governance can be deducted. To hone my theoretical argument for application in the empirical field, I thus analyzed eight major blackout events of the last 12 years and explored which constellations of actors, places and dynamics were *disrupted* in favor of novel constellations. As a result of this discussion I generated a list of further empirical research questions that possess fundamental relevance with regard to the discussion on the transnationalization of electricity governance systems (end of this chapter). The next subsection

gives some information on the methodological aspects of my content analysis before I introduce my preliminary findings.

## Empirical method

### Case selection

I will take account of two broadly defined economic regions in my analysis. The first one is the Western industrialized world, exemplified by the highly cross-linked regions of Northern America (USA and Canada) and Europe. The second one is an emergent region situated in the Southern Cone of Latin America that roughly corresponds to the more powerful parties of the economic bloc of the Mercosur. Both regions will help to shed light on the case study of electricity networks in Latin America. The western industrialized world is important because it is characterized by *assemblages* of high density and broad expansion: various and diverse free trade agreements (FTA's) and integration treaties are in place and, according to my argument, they are supported by an extraordinarily large number of multi-faceted and multi-directional technological connections – most of them linked in one way or the other to electricity. For this reason the blackouts affecting Northern America (2003) and Europe (2003a; 2003b; 2006) constitute a first and large part of the research sample under anylsis here. On the other hand, the emerging economies of Argentina and Brazil will be at the heart of my case study and therefore it is of major importance to compare the insights on re-configuration of power relations in blackout evens from the industrialized region's sample with those that represent the electrical reality in the Latin American region under study. For this region the major blackouts in the sample are the Brazil/Paraguay blackout (2009), that was also transnational in character like the Northern American and European blackouts, and the three nationally circumscribed blackouts of Brazil (1999)[32] and Argentina (2007 and 2008). Despite their limitation to single countries and even small regions within these, the two latter blackouts are included in the sample for a better estimation of local conditions of electricity networks in the relevant area of my case study on Argentina and Brazil. To summarize, the following eight blackout incidents are going to be studied:

[32] This blackout was not included in the original selection of the blackouts before my fieldwork but was added after the fieldwork because of its significance for our understanding of the reorganization of the energy market in Brazil. The time frame for analysis was thus expanded ex post to include also the years of 1999-2003.

Argentina 2007, 2008; Brazil 1999, 2009; US/Canada 2003; Europe 2003a ("Sweden/Denmark"); Europe 2003b ("Italy"); Europe 2006 ("Germany"); [33]

**Document selection**

The documents to be analyzed were selected on the basis of two conceptual considerations. In the first place I selected a number of newspapers with the highest circulation in the countries affected by the blackout events.[34] [35] This selection was aimed at gathering information on the sociotechnical assemblages from the perspective of the public, i.e. to understand which groupings and issues were visible and predominant in the popular debate on causes, consequences and political challenges of the blackout events. The analysis starts in 1999[36], point of time of the first major blackout event under analysis, and finishes on the 31 of December of 2010. The selected newspapers are exemplified in Table 1 below. The keywords I used were respectively the English, German, Italian, Spanish, and Brazilian Portuguese word for blackout as well as an indication of the countries under investigation. The list of keywords is exemplified in Table 2 below. In total, 97 newspaper articles were selected for this analysis.

TABLE 1: NEWSPAPER SELECTION

| **Country Affected** | **Newspaper(s) with highest circulation** |
|---|---|
| United States | The Wall Street Journal<br>USA Today<br>The New York Times<br>Los Angeles Times |
| Sweden and Denmark | Due to language limitations: pool of all newspapers mentioned |
| Switzerland | Neue Zürcher Zeitung |

[33] The exact dates and locations of the blackouts are presented in the section on preliminary results (below).

[34] The researcher selected three to five of the most relevant newspapers of each of the countries concerned by the blackout events. The Europe blackout of 2003 in Sweden and Denmark constitutes an exception due to the researcher's language skills: since I do not speak Danish or Swedish I was forced to rely on international news coverage only here (same newspapers as for the other blackouts).

[35] I had to desist from analyzing The Washington Post, The Times, The Buenos Aires Herald, and the Frankfurter Allgemeine Zeitung because of restricted access to the online documents. I furthermore excluded the International Herald Tribune since it is economically and editorially associated to the NY Times.

[36] C.f. Footnote 29.

| | |
|---|---|
| Germany | Die Zeit<br>Süddeutsche Zeitung |
| Italy | La Repubblica<br>Corriere della Sera<br>Il Sole 24 Ore |
| Argentina | La Nación<br>Clarín |
| Brazil | O Globo<br>Jornal do Brasil<br>O Estado de São Paulo<br>Folha de São Paulo<br>Correio Brasiliense |
| Paraguay | ABC Color<br>La Nación<br>Ultima Hora |

TABLE 2: KEYWORDS FOR ARTICLE SELECTION

| **Language** | **Keyword** |
|---|---|
| English | blackout, disruption, power outage US, Sweden, Denmark, Europe, Italy, Switzerland, Argentina, Brazil, Paraguay |
| German | Blackout, Stromausfall, USA, Schweden, Dänemark, Italien, Schweiz, Argentinien, Brasilien, Paraguay |
| Italian | blackout, Italia, Svizzera, Svezia, Danimarca |
| Spanish | apagón, corte, corte de luz, Argentina, Brasil, Paraguay, Suecia, Dinamarca |
| Brazilian Portuguese | blecaute, apagão, Brasil, Paraguay, Argentina, Suécia, Dinamarca |

To gather more information on the technical specificities of the disruptions, I selected a few of the technical disruption reports that had been issued ex post on the different blackout events and added them to the database for more information on the technical specificities of the disruptions. The timeframe under analysis is the same as for the newspaper articles, i.e. 2001-2010. Table 3 summarizes the selected documents.

TABLE 3: TECHNICAL DISRUPTION REPORTS SELECTED FOR ANALYSIS[37]

| **Blackout** | **Selected reports** |
|---|---|
| US 2003 | • US-Canada Power System Outage Task Force (2004): "Final Report on the August 14, 2004 Blackout in the United States and Canada: Causes and Recommendations." |
| Europe 2003a | • Elkraft System (2003): "Power Failure in Eastern Denmark and Southern Sweden on 23 September. Final Report on the course of Events".<br>• IEA (2005): " Learning from the Blackouts Transmission System Security in Competitive Electricity Markets" (p. 90-99). |
| Europe 2003b | • UCTE (2003): "Final Report of the Investigation Committee on the 28 September 2003 Italy Blackout". |
| Europe 2006 | • UCTE (2006): "Final Report System Disturbance on November 4th 2006." |
| Europe 2003a, 2003b, and 2006 | • Project Understand (2007): "White Paper on Security of European Electricity Distribution." |
| Argentina 2007 | • No publicly available reports found[38] |
| Argentina 2008 | • No publicly available reports found[39] |
| Brazil 1999 | • No documents dedicated exclusively to this blackout found. Some data could be extracted from the ANEEL reports on the Brazil/Paraguay blackout of 2009 (below). |
| Brazil/Paraguay 2009 | • ANEEL (2010): "Relatório de fiscalização RPTE"<br>• ANEEL (2010): "Relatório de fiscalização LTT"<br>• ANEEL (2010): " Relatório de fiscalização ONS" |

[37] I selected documents related to the technical analysis of the disruption events. Since different countries have different disclosure policies it was not possible to find exactly equivalent documents for all the blackout events. However, the documents are comparable as they put the focus of their investigation on technical, economic, and political origins and consequences of the pertinent blackout events. Selecting merely the final reports of the responsible entities is considered as appropriate here, since this qualitative content analysis is merely the preliminary analysis to the Garabi case and hence I decided to favor breadth versus depth of analysis.

[38] Due to Argentinean disclosure policies it was not possible to find an adequate document.

[39] Due to Argentinean disclosure policies it was not possible to find an adequate document.

**Preliminary findings of blackouts analysis**

The following interpretative accounts present the preliminary findings of the content analysis[40]. The value of the interpretative accounts for each blackout lies in the empirical description of the movements of association between individual human and nonhuman entities that may be observed in the eight cases of disruption as well as in a succint appraisal of the reconfiguration of established configurations.

The aim of this explorative blackout analysis is to examine the postulatedrelevance of the questions on the human-nonhuman interplay in transnational energy governance by grounding them in empirical material on transnational electricity systems. The aim of the analysis is *not* to *exhaustively* highlight how technical, social and political elements intertwine in these eight cases of electricity disruption. Rather do the presented interpretative accounts give an idea of the possible (re-) arrangements of human and nonhuman actors which then can be used for further specification in the case study that stands at the center of the next chapter, that is, the planning and construction of a large hydro-electric utility between Argentina and Brazil.

No more was it the aim of this chapter to determine differences in the type and nature of the news coverage on every single blackout event or its exactitude. Even if sometimes similar concerns might apply for different cases, the contents and data found for each blackout differ greatly in their exactitude and their discussion of related contemporary electricity debates. A further clarification of both the entities that effectively contributed to the materialization of each blackout and of the future-related speculations voiced by the press would call for further in-depth research. This deepening of the empirical case of the blackouts is however not within the scope of the present thesis.

The interpretations presented in the subsection on interim conclusions therefore do not yet answer the questions on the reconfiguration of authority hierarchies in transnational electricity governance comprehensively. Under the assumption of an ontology of the multiple (Mol 1999) their value rather consists in presenting a "general sense of the working" (Orr 1996, 14) of electricity systems in regions of medium to high density and broad territorial expansion. Though other blackouts may not develop in exactly the same way as the ones described here, "some combination of the following descriptions or variations of them can be regarded as making up such" events regularly (Orr 1996, 14). The reader is invited to read all the cases chronologically

[40] A summery of the arguments presented in the interpretative accounts can be found in the tables in the appendix "working materials" (tables 6 to 13).

or to jump between them. Also it is possible to jump directly to the interim conclusions part of this chapter as the main movements of association on group boundary re-organization are summarized there.

**Argentina blackout May 17th 2007**

In the case of the Argentinean blackout in May 2007, the power outage was caused[41] by the outbreak of a fire in an electricity transformer station situated in Ezeiza, the capital of the homonymous municipality situated in the South of the Greater Buenos Aires region. It is not clear from the news articles how the fire might have been ignited: the first hypothesis ponders the possibility of an overloading of transmission lines due to the increased use of air conditioning in private homes as well as commercial and industrial offices of Buenos Aires that day. It is this increased use that might have caused a short-circuit in one of the three individual 800MW transformer units situated in Ezeiza. However, the hypothesis of overload due to excessive use of air conditioning gave reason for *contestation* because the temperatures registered in Buenos Aires on that day of mid-May were not especially high (16.8°C according to http://www.tutiempo.net/clima/Buenos_Aires_Aerod/05-2007/875820.htm [31.12.2012]). Thus, the second hypothesis that was investigated by officials of the Ministry of Planning and Public Investment of Argentina at the behest of Planning Minister Julio de Vido is malicious arson.

Irrespective of the *origin* of the fire, the tripping of the single 800MW transformer unit eventually lead to the disconnection of the whole transformer station via the automatic protections that are built into the substation's power transformers. Substations are a critical component of the electric power system as they transform voltage from high to low or vice-versa, and are therefore protected from disruptive incidents via automated protection devices. Protection devices detect abnormal and intolerable conditions within the substation and disconnect it from the system if necessary to ensure the continuity and reliability of the overall electricity system as well as to minimize damage to the transformer station itself. As the substation of Ezeiza was disconnected from the Argentine electricity grid, the flow of electricity between Transener, the national operator of high voltage transmission lines, and Edesur and Edelap, the regional operators of medium voltage distribution lines, was interrupted (N.N. 2007).

[41] Whenever I talk about 'causes' with regard to the blackouts at hand or with regard to the construction of large infrastructure power plants I am always thinking of a network of agencies under the premises of my theoretical synthesis explained in chapter four.

Despite abundant generation in the network and the impeccable functioning high voltage transmission lines, supply to customers of Edesur and Edelap was thus cut-off because of the failure of this crucial transformer station.

Technically, the fault in this power outage can be considered as a minor n-1 incident.[42] However, due to its location at one of the critical interfaces of *national* transmission and *regional* distribution of electricity the breakdown of the transformer station led to the disruption of electricity provision for the whole Greater Buenos Aires area. Socially, the disruption of the technical connection between the provinces where energy is produced and the provinces where energy is consumed also represents a social disruption of the social market relationship between customers and supplierss and the political relationship between the government and market authorities to name only two of the re-configured relationships. The shift in authority becomes visible in the follow-up to the blackout situation: To repair the damage, Transener, the owner and operator of the power station immediately started working on the recoupling of the national transmission and regional distribution lines, as the CEO of the company, Silvio Resnich, stated publicly (N.N. 2007). Because the substation represents one of the main connections of the low voltage regional distribution grid to the high voltage national transmission grid, it was particularly difficult to stream in additional electricity from somewhere else in the region.

Indeed, a better national interconnection of the generally radial electricity grid of Argentina (Rudnick, et al. 2005, 50) had been addressed late by the government, that is, only in the national government's National Energy Plan (Plan Energético Nacional) spanning the years of 2004-2008 (Cameron and Comision Nacional De Energia (CNEA) 2004). Lots of investments were however still pending as of 2007. In the end, the blackout lasted fairly short because there was the possibility of covering the Argentinean demand via energy generation from Brazil. For this the binational substation of Garabi and approximately 355km of a 525KV line along the 50 Hz Rincon-Garabi line, situated in the northern part of Argentina, were used. And there are more relevant international interconnections to credit for the fast restoring of electricity service: The Garabi substation and the corresponding transmission lines had been contracted as of 1999 by the Swiss company ABB (Graham, et al. 2002) to facilitate electricity trade between the two Southern Cone economies (Menzies, et al. 2001, 1). Politically, the construction of the substation

[42] De Keulenaer defines the n-1 criterion as follows: "The N-1 criterion expresses the ability of the transmission system to lose a linkage without causing an overload failure elsewhere. The N-2 criterion is a higher level of system security, where the system can withstand any two linkages going down. Details that accompany the N-1 and N-2 criteria give further information on the robustness of the system" (De Keulenaer 2006).

was rendered possible by the signing of an agreement between the governments of Argentina and Brazil on May 5, 1998 (Graham, et al. 2002, 1). Originally, the substation had been constructed for the reverse trade situation, that is to sell 1000 MW from the wholesale energy market in Argentina to the Brazilian company Companhia de Interconexão Energética (CIEN) (which was then owned by the Spanish ENDESA Group).

In the face of these multiple local-global linkages, two things become visible with regard to the postulated shifts in social relationships (customer-supplier relationship, relationship between central government and market authorities): first, we can see how the significance of a circumscribed group of Argentine energy suppliers becomes reduced in favor of another group of Brazilian producers when a set of traditional distribution lines to transport the energy are no longer available. Had it not been for the existence of the technical interconnection between Argentina and Brazil – originally constructed for another purpose - and the existence of additional transmission lines from the Garabi substation to other nodes of distribution operated by Edesur and Edenor, the Greater Buenos Aires could not have been supplied with energy until the problem at the Ezeiza substation was solved. For the national electricity producers who could not supply their energy anymore this means that the construction of additional transmission lines and converter stations that reliably connect them to the Greater Buenos Aires region is central to remain in business. Without a reliable connection to the centralized distribution system they are excluded from an important part of the market and incur the risk of financial losses and a thus a reduction of the economic viability of their plant. In such a case they might consider re-locating their generation somewhere else or, in the worst case, closing it down. This means that the balancing of the economic viability of energy producers by the state government and the national industries is central for the economic growth and the overall prosperity of the country. Situated knowledge on each such blackout event should be used by the transmission system operators and planners to strengthen its transmission grid at sensitive points.

Second, it becomes visible that the power of the government to reestablish a functioning service is indirect. That is, despite the fact that this power is distributed in existing regulation toward the hands of the national transmission system operator (government-dependent), it is Transener (private company), who actually possesses the necessary skills and relationships that enable it to fix the disruption. In addition it is in the hands of the neighboring country's producers and transmission systems operators because it is them who possess the power to alter generation and

trade patterns. The government is thus dependent on a wider assemblage of individual agencies within which agency (the distribution of energy from Brazil) emerges.

**Argentina blackout January 15th 2008**

In the case of the Argentinean blackout in January 2008, the power outage originated in a failure within a sewer pumping station in the city of Almafuerte, in the province of Córdoba, Argentina. Due to this failure the load on the transmission lines increased dramatically as the pumping station, a huge public utility, was no longer consuming any electricity.

The day of January 15th was especially hot with temperatures above 30°C (La Nacion, N.N. 2008). With such high temperatures air conditioning functions at its peak in Argentina forcing the electricity system operators to schedule additional electricity generation at power utilities across the grid. If one large energy *consuming* utility experiences a failure in such a situation of high electricity flow in the grid the electric load on the transmission lines increases sensibly. In such an eventuality, operators need to dispose of real-time data on the flows of electricity and the overall status of the grid to adopt appropriate measures to reduce the load on the transmission lines.

Technical possibilities are the diversion of electricity flows towards foreign countries, the connection of other domestic high-consuming utilities as, for example, pumped-storage hydro power stations, the immediate reduction of power generation in peak load *generation* plants and the requisition of additional production in average load power plants (Boyle 2011, 361). The coordination between the reduction of generation in peak load power plants and the concomitant increase in production in average-load power plants is a complex procedure that needs to take into account the different spatiotemporal characteristics of the various involved plants as well as of the transmission system: location in the interconnected grid, lapse of time until the produced energy is delivered to the consumer, material possibilities of transportation of the electricity via the available lines, shut down and boot-up time, estimated costs of these procedures and consumption as well as production forecasts at different nodes in the grid. Besides real-time data on the grid, the prerequisites of such a rescheduling of loads is the availability of serviceable transmission lines and a sufficiently intermeshed system or else it is not possible to successfully detract the surcharge from the lines.

In the January 15th 2008 blackout that affected the province of Córdoba it was apparently difficult to divert the flow of the loads towards sufficient other lines. The overload of the system resulted in the tripping of a transformer station, which disconnected the provincial service provider Empresa Provincial de Energía de Cordoba (EPEC) from its supplier of high voltage electricity Transener. Additionally, the tripping of an other transmission line in Bahia Blanca, in the South of the province of Buenos Aires, which was also due to overload, triggered the disconnection of another transformer station which resulted in a further reduction of diversion possibilities for the operators of EPEC. The overload of the electric lines led to a regional disruption of electricity service. The lights went out in a large number of Córdoba's municipalities.

According to Jorge Samek, the speaker of the provincial control organism for electricity, the blackout's institutional underpinnings lie in the lack of investment in medium voltage distribution lines over the course of the last 40 years (Lasalvia 2008). The outage also triggered reactions from the municipal governments of Formosa, Mendoza and San Luis. As politicians advanced a request to opt out of daylight-saving regulation in the wish to reduce household consumption of energy in hot afternoons and evenings (air conditioning) as well as in early morning (lighting) (Lasalvia 2008). Sociotechnically this blackout illustrates how a single energy consumer can suddenly become of prominent significance vis-à-vis other energy consumers in the grid. In the highly complex web of interactions of the electricity system in which every activity of producers, transmission operators, distributors and consumers is planned and monitored in real-time. Under a high temperature situation, the energy *producers* play a prominent role as they are asked to generate additional electricity to supply the air conditioning appliances. The whole grid is geared towards *producing* the energy requested by the consumers. In such a situation, the failure of a large energy consumer denotes a turnaround for electricity planning. Suddenly there is too much electric current on the lines. The operator sets in motion all the options available so that additional energy is *consumed.* However, activating additional energy-intensive utilities also implies the necessity of convenient transmission corridors – which is in turn dependent on sufficient public and private investments. From this blackout we can see how the clustering of two short-circuits in a territorially speaking *extended* region (distance between Almafuerte, province of Córdoba, and Bahía Blanca, Buenos Aires province, is around 1'000 km) may put a heavy strain on the available transmission options. This illustrates once

again how the deviation of current is not only dependent on the agential capacities of humans but also on the intermediation of material infrastructures.

**Brazil blackout March 11th 1999**

In the case of the Brazilian blackout of March 11th 1999 public authorities divulgated the information that it was caused by lightning striking an electric substation in Baurú, in the Brazilian state of São Paulo. As described for the previous blackouts, the defect in the substation caused power supply to the region to be interrupted. As the demand for energy remained high due to the persistent high temperatures in early March, the load on the transmission lines increased to an untenable level and caused the disruption of the power system via the automated activation of protection devices. The electric authority Furnas Eletrobras who was involved in the assessment of the causes of the disruption immediately after the blackout found no deviance from normal operation in the grid or its power utilities (Estado de Sao Paulo, N.N. 2002). What was clear however is that Brazil had long postponed its investments in additional transmission lines as well as alternative sources of power generation that could support the large share of hydro when under strain (Jornal do Brasil, N.N. 2009b). At the moment of the blackout, Brazil was undergoing a large period of drought. With its energy matrix composed of around 90% hydro (Rother 2001) it was already in the middle of a significant energy crisis with its rivers at very low flow levels and the reservoirs of its pumped-storage hydro stations empty. In this situation two different but related drivers of energy supply failed: due to its limited investment in the electricity grid (mainly the lack of interconnection between the four main economic regions of the country but also the lack of mid-voltage distribution lines (Tolmasquim 2011), Brazil was neither capable to stream in the electricity via other regions around Sao Paulo. On the other hand, it could not cover the demand in energy via the local production of other forms of energy generation either because the available plants were too few. Despite the plans for a second nuclear reactor being very old it only came online late in the year 2000 (Rich 2000). Similarly, plans for gas-run power plants were at a very early stage despite the forecasted (as of 2000) need of 26,000 megawatts of new electricity that Brazil would need for the period of 2000-2005 (Rich 2000). According to different sources, the Asian financial crisis might additionally have impinged on the financing capacity of electricity companies by reducing the inflow of foreign

capital and consequently the leeway for national investments in the electricity system (Rich 2000).

In total the blackout affected approximately 16 states in the southeast, center-east and northeast regions of Brazil, among them e.g. Parana, Rio Grande do Sul, Mato Grosso do Sul, Santa Catarina and the southern part of Minas Gerais. Several important economic hubs as Sao Paulo, Rio de Janeiro, Minas Gerais, Salvador de Bahia, Recife, Porto Alegre and Curitiba were plunged into the darkness (Gosman 2001b). The blackout spurred huge changes in Brazil's approach to energy policy: as of July 2001, households, economic players, as well as public service providers and ministries were forced to drastically reduce energy consumption by at least 20 %. In addition to the launch of awareness policies including the change of consumer behavior the government also implemented a series of forced energy rationing for around three to eight hours starting from approximately six o'clock in the afternoons (Rother 2001). Foreign companies were thus forced to rethink their business models and location because of the restriction on working hours and the need of more diesel-fired auto-generators which inflicted them additional costs (Rother 2001, Gosman 2001a). According to concerns voiced by economic commentators at the time when rationing was introduced, Brazil would lose a large share of employments (DPA and AP 2001) and incur the risk of hyperinflation (Gosman 2001a). In large cities affected by high criminality such as Rio or Sao Paulo the rationing also made a difference for the local police forces who were forced to enlarge their staff and increment their hours of patrolling due to long hours of darkness (Gosman 2001b).

One could comment on a lot of other shifts taking place in a blackout as the one that took place in 1999 in Brazil. But maybe it is most intriguing how a single natural hazard as electric lightning may function as the trigger for the reorganization of electricity distribution within an electricity grid. It is interesting and telling how the material *condition* of low rainfall forced the immediate re-organization of Brazilian energy production despite the originally slower planning schedule that had been set up by the energy authorities in control. Additionally, it is important to recognize how a cheap production location suddenly loses its importance for international business when low rainfall reduces the supply of energy: before the drought, the existence of an extended hydro matrix in Brazil was highly valued because it allowed low costs of production. Under the condition of drought the extended hydro matrix suddenly becomes a burden because it requires the introduction of additional diesel or gas-fired auto-generators, thus provoking an

increase in the costs of production. From an attractive manufacturing base, Brazil becomes a cost trap without having *intentionally* changed a thing in its energy and industry policy.

**Brazil blackout November 10th 2009**

The Brazil Blackout of November 10th 2009 appears to have been triggered by the failure of a transmission line in the Southern part of the country, on a single-current circuit between Itaberá and Ivaiporã. Among the specialists from the electricity and meteorology sector, however, a controversy developed with regard to the probability that a storm raging at 40 km distance might have caused that technical fault in the transmission line. According to a professor of energy and automation at the Polytechnic of Sao Paulo, the transmission lines are designed to withstand wind speeds of 130km/h. This wind speed cannot have been registered in the night of November 10th 2009 due to the increased distance between the storm and the transmission line (Agência Brasil 2009). Independently of the probability of a natural hazard causing the disruption, the tripping of the Itaberá-Ivaiporã power line caused the tripping of interconnected power lines operated by the company Furnas as well as the disconnection of the Itaipú Hydroelectric Utility (HEU) via the automated activation of the protection devices (Da Silva and Sobreira Rolim 2010). According to the manager of the HEU of Itaipú, the power plant was functioning normally and without defects but was disconnected to prevent major system accidents. The HEU of Itaipú supplies around one quarter of Brazil's demand for energy (Marti 2009) and represents the largest binational hydro dam in Latin America at present. Situated in the border triangle between Brazil, Paraguay and Argentina it is an important energy supply point for the states of Sao Paulo, Santa Caterina, Paraná and Rio Grande do Sul. Especially the former three possess high economic power within the Brazilian national economy. But the disconnection of Itaipú was not the single cause of the instabilities in the grid. Due to the disconnection of several transmission lines and the HEU of Itaipú the nuclear power stations of Angra I and Angra II, situated on the Iaorna Beach in Angra dos Reis, Rio de Janeiro, were also put offline and urgently connected to diesel-generators to keep the cooling system operative (Correio Braziliense, N.N. 2009a). The blackout affected 40 million people. The lights went out in 800 cities, including major economic hubs such as Sao Paulo and Rio de Janeiro (Reuters 2009). Parts of Paraguay were also affected by the disruption but service was restored within around 30 Minutes (Marti 2009).

Despite the altered conditions between 1999 and 2009, the blackout incident triggered renewed interest in the state of the Brazilian infrastructure system as well as specifically in public and private investments in a diversified production of energy (Campbell and Brito 2009).

With reference to the Brazilian energy crisis and necessary rationing measures of 2001, several Brazilian parties advanced doubts on the then energy minister Dilma Rousseff's qualifications to be the future head of state. According to them her responsibility in the mismanagement of the energy sector are an occasion for political worries (Campbell and Brito 2009).

Still with regard to the state of the national electricity infrastructure, especially international commentators further raised concerns about the countries capability to host the Olympic Games in 2014 and the Football Cup in 2016 – a huge opportunity for the country's economic growth and arrival on the international political arena (Lyons 2009). In Brazilian media as well as in the United States the hypothesis of cyber terrorism was pondered. On the one hand forms part of standard regulatory procedure to check for hacking eventualities in the case of a disruption event, on the other hand the blackout nearly coincided with a documentary broadcasted by American news company CBS in which the Brazilian blackouts of 2005 and 2007 had been used as a an illustration for the dangers of hacker attacks on the US energy system (Gosman 2009). For the speaker of the Regional Commission for Energy Integration (CIER), Gabriel Argüello, the Brazilian blackout is an indicator of the lack of investment and integration also in regional electricity infrastructure (Algañaraz 2009).

What is worthwhile noticing in this 2009 blackout that affected large parts of Brazil and smaller parts of Paraguay is the unequal significance of the HEU of Itaipú for the two countries: despite the *formal* regulatory provision to share the ownership of generated energy on a 50-50% basis, it becomes visible from the geographical scope of the disruption that Brazil is much more dependent on the generated energy than Paraguay. The HEU of Itaipú lies in a strategic geographic corner of Brazil and provides energy to some of the states that are of greatest economic significance for the country. Due to its large installed capacity (around 12 GW) few alternatives were devised in the region and therefore there were no additional power plants that could be drawn on at the time of disruption in the region within an appropriate time limit[43].

[43] Particulary because the two nuclear power plants Angra I and Angra II were also out of order.

**United States – Canada blackout on August 14th 2003**

Official statements of the United States and Canada immediately after the blackout event are inconsistent with each other regarding the trigger of the disruption on August 14th 2003. While the United States postulated the hypothesis of an overload in a generator plant somewhere close to Niagara Falls, the Canadians suggested natural hazard in the form of lightning to be the cause for this situation. (Clarin, Thanh Dang 2003, N.N. 2003b-b). According to the binational U.S. - Canada Task Force the cascading of the instability across an extended part of the grid could have nevertheless been prevented if the energy company First Energy and its reliability council ECAR had appropriately assessed and understood the inadequacies in the transmission system. The task force imputes First Energy to be guilty of not disposing of adequate operation procedures for contingency analyses, guidelines for monitoring, internal communication and the testing of monitoring tools as well as for the use of back-up monitoring tools. Other interconnected causes of the blackout detected by the task force were insufficient tree trimming which led to the flashover of overcharged transmission lines in Dayton Power and Light's Stuart-Atlanta lines as well as the lack of communication and communication guidelines or procedures between the PJM Interconnection LLC and the Midwest Independent Operator, two regional transmission operators responsible for the region affected by the blackout. According to the task force these were the main features that led to untimely restoration responses (U.S. - Canada Power System Outage Task Force 2004, 18-19).

As many as 21 power production plants, nine of them nuclear were put out of order during the blackout (Cardoso 2003). Subways, elevators, television services, airports, hospitals as well as industries and financial centers experienced interruptions in extended areas of the Northeastern and Midwestern Unites States, and Ontario, Canada (Athans 2003). The cities affected by the largest losses due to a lack of economic activity were New York, Cleveland, Detroit and Toronto. In Cleveland and Detroit especially the automobile producers were heavily affected by the impossibility to operate their production facilities (Corriere della Sera N.N. 2003a-b). Luxury shopping destinations like the 5th Avenue in New York and airline companies were also seriously affected by the loss of sales (Corriere della Sera N.N. 2003a-b). Interestingly, the telephone system was not affected by the disruption but continued working under normal conditions. It did register an overload in its telecommunication lines, however, due to the high frequency of calls operated by the public (police, fire brigades, news broadcasters, utility engineers and electricians, family calls etc.) (Athans 2003): "AT&T reported that its nationwide network was

receiving about 2.6 million calls every five minutes late yesterday afternoon, compared with about 2 million in a typical day“ (Athans 2003). The disruption animated the American Society of Civil Engineers (ASCE) to edit a manifesto against the dire state of North American civil engineering infrastructures for which investments of 1.6 billion U.S. dollars are required (Pataro 2003). The critique voiced by the ASCE in 2003 found endorsement by the wider public also because the U.S. congress had dismissed the investment plans laid out in the national transmission grid study of 2002 (U.S. Department of Energy 2002) only a few months earlier to the blackout event (Cardoso 2003). The critique became globally known when the then incumbent president, George W. Bush, as well as former minister of energy under president Bill Clinton, Mr. Bill Richardson (Baron 2003), declared that the USA are “a superpower with a third world electricity grid“ (Baron 2003).

Besides the critique on the U.S. infrastructures, the blackout event also triggered memories of 9/11 and allegations of strategic terrorist attacks prepared by Al Qaeda and other muslim organizations thus converting the electricity disruption in an supposed affair of national security to be handled by the FBI and CIA (Clarin, N.N. 2003a-a, 2003b-b). This hypothesis on terrorism was however abandoned soon after the start of the first investigations.

What we can see from this blackout is how the disconnection of a transmission line due to flashover with a tree brings locally situated forestry activities to the foreground of regional energy policy. Whereas we do not pay attention to the importance of local tree trimming for regional electricity planning under normal transmission operation, the inadequate shape of a tree gains relevance in the context of overloaded transmission lines. Besides it constitutes striking evidence to learn that territorially speaking *adjacent* transmission system operators within the *same* nation state (the U.S.) did not possess integrated communication procedures or systems to prevent the blackout, despite working at the interfaces of one integrated system spanning different political-administrative sub-regions. The relational shift that we can witness here is thus one of a splitting between two system operators of the *same* nationality vs. the conflation of the *distinct* national territories of the U.S. and Canada in one single geographic territory. In other words, we see that two administrative units that pertain to the same nation are organized completely independently of each other, whereas they are closely entrenched in reality. Once again, this illustrates how group boundaries, such as e.g. territorial demarcations, are not naturally given but need to be functionally related to its context.

**Europe 2003a blackout between Denmark and Sweden on September 23rd 2003**

The blackout between Denmark and Sweden that took place on September 23rd 2003 was received by the wider public as a shock on the state of the highly industrialized Nordic countries' electricity infrastructure. Only a few weeks after millions of North Americans were plunged into the darkness, a part of the Scandinavian electricity grid was disrupted because of the combination of several decentralized technical faults. According to the International Energy Agency the disruption originated in the simultaneous unfolding of several minor technical faults distributed across Denmark, Sweden, Finland, and Norway (International Energy Agency 2005, 90-99).

The narrative starts with several Swedish nuclear power plants being out for maintenance and an additional one having to be shut down unexpectedly due to technical problems. According to the transmission systems operators this represented a normal n-1 situation, that is, a situation where the transmission system loses a linkage without this incident causing an overload failure elsewhere in the electricity system (De Keulenaer 2006). However, the unexpected out of order of this power utility automatically generated a request towards interconnected Norwegian, Swedish and Finnish power plants to authorize the outflow of additional generation capacity towards Sweden. The immediate inflow of electricity from these power plants contributed to further instabilities in the grid, which, however, could also have been managed by the transmission system operators if a double bus bar failure caused once again by a flashover with a tree had not occurred immediately after the shutdown of the nuclear power plant on the West Coast of Sweden (Silvast and Kaplinski 2007a, 41). This additional bottleneck contributed to the tripping of four important power lines between Central and Southern Sweden, Sweden and Continental Europe, and Zealand and Germany. The initial incident thus evolved into a serious n-2 situation (Silvast and Kaplinski 2007a, 41) in which, for example, "additional feed in points from lower voltage networks are needed to provide reserve supply, so the low voltage network itself may act as a power conduit" (De Keulenaer 2006). Silvast and Kaplinski describe the rest of the blackout situation as follows:

> "The sudden loss of generation and transmission capacity triggered large power oscillations, low voltages and a drop in system frequency, leading to automatic under-frequency load shedding. Power flows increased on the remaining lines between central and southern Sweden, and this flow was amplified by responses from generators in northern Sweden, Norway and Finland to the loss of the nuclear units. After 90 seconds,

> the power oscillations began to fade and the load levels began to recover, leading to even further stress on the 400 kV transmission links between central and southern Sweden.

As a result, the voltage levels on the 400 kV transmission lines dropped to critical levels, and this led to voltage collapse in the transmission network of the southwest of Stockholm. Distance relays in central and southern Sweden registered this event as a distant short circuit, severing all remaining lines between northern and southern Sweden. An electrical island formed, consisting of southern Sweden and eastern Denmark. The large generation deficit led to collapse of frequency and voltage, triggering generator and network protection devices. The islanded system collapsed at 12:37pm and Eastern Denmark was automatically disconnected from southern Sweden by protection devices on the link between the countries" (Silvast and Kaplinski 2007a, 41).

In total, about three million people in Sweden and Denmark were disconnected by the blackout. Traffic Lights, light bulbs in households, schools, offices and industries went out around 12:40 hrs. Hospitals immediately connected their emergency generators (Sueddeutsche dedpa and AP 2003). The Copenhagen Police urged people to stay where they were in order to prevent large traffic jams on highways expected due to the malfunction of public transport systems (Sueddeutsche dedpa and AP 2003). The Danish airport of Copenhagen Kastrup was out of order for a short duration of time, during which all flights were rerouted towards Sweden. Luckily, service was quickly restored. There were no disruption notices from airports in Frankfurt (Germany) or rail traffic in German areas close to the Danish border (Sueddeutsche dedpa and AP 2003).

One interesting shift that we can observe in the 2003 blackout between Denmark and Sweden is that there exists a practical sociotechnical integration not only between the countries of Sweden and Denmark (both affected by the disruption) but between the countries of Sweden, Denmark and Finland, which becomes visible by the automated generation request that was triggered in the after-math of the currency reduction in the Swedish transmission grid. As soon as the frequency loss in the Swedish system was detected by the operators, an automated request for generation reached the operators in Denmark and Finland, and led to the integration of foreign generation utilities into the Swedish system operator's calculations. Additionally, and just like in the U.S.-Canada Blackout of the same year, the flashover of a transmission line with a tree led to the territorial re-organization of the electricity distribution services across a previously national electricity grid.

**Europe 2003b blackout between Switzerland and Italy on September 28th 2003**

The Blackout of September 2003 between Italy and Switzerland that originated with the failure of the 380kV Mettlen-Lavorgo transmission line, also known as the Lukmanier power line in the canton of Ticino, Switzerland (Silvast and Kaplinski 2007a, 38). It led to 1.5 hours of electricity interruption in Switzerland and 18 hours of interruption in Italy. The failure was due to the high loads circulating on the line at the time of disruption (Sunday Morning, 3 a.m.) and the insufficient tree cutting along the line which led to a short-circuit by means of a flashover with a tree. To prevent a bottleneck in the grid, the Swiss system operator ETRANS (today Swissgrid) phoned the Italian system operator GRTN and asked them to reduce Italian power imports by an amount of 200-300MW, approximately the amount that Italy was importing above the level of scheduled power transfers (Biondani and Sarzanin 2003, Silvast and Kaplinski 2007a, 38). However, after the Lukmanier power line had failed, the load level increased on other interconnected power lines. Another important interconnection between Switzerland and Italy, the Sils-Soazza line began operating at 110% of its capacity. The Swiss operator Etrans had 15 minutes to reduce the load on the grid before this line would also trip due to significant overload. Unfortunately, another flashover with a tree forestalled the system operators and caused another short-circuit in the canton of Ticino, Switzerland (Silvast and Kaplinski 2007a, 38). Several other lines in Switerland, between Switzerland and Italy, and between Switzerland and France tripped and led to the desynchronization of the Italian electricity system from the Union for the Coordination of Transmission of Electricity (UCTE) system (Silvast and Kaplinski 2007a, 38). From then onwards, the instability phenomena started within Italy itself. Several generator plants tripped and due to the desynchronization from the UCTE a generation shortage accompanied by a fast drop in frequency was experienced (Silvast and Kaplinski 2007a, 38). “Primary frequency control, automatic shedding of pumped storage power plants and some industrial demand helped to slow the rate of decline, but could not prevent the collapse of the entire Italian power system” (Silvast and Kaplinski 2007a, 38). Due to the chronic system failures in Italian electricity systems, the media first attributed the blackout to the Italian transmission system operator GRTN (Sueddeutsche.de, et al. 2003). In the immediate aftermath, the competent energy authorities and the department of public prosecution in Rome coordinated a fact-finding commission to determine responsibilities (Corriere della Sera, N.N. 2003b-a). It is telling to have a glance at the

composition of the fact-finding commission: it was chaired by the president of the Polytechnic of Milan, Prof. Adriano de Maio and included other seven members: Antonio Catricalà, secretary at Palazzo Chigi, the Italian government, Ennio Macchi of the Polytechnic of Milan, Giancarlo Manzoni, president of the CIGRE Committee, a large Committee dedicated to the study of large technical infrastructure, Alessandro Ortis, general director for energy at the Ministry for Productive Activities, Luigi Paris, professor for electric systems at Pisa University, Carlo Secchi, rector at Bocconi University in Milan, and Luigi Gianpaolino, head of cabinet of the Ministry of Productive Activities (Corriere della Sera, N.N. 2003e). The composition shows the many areas of interconnection that need to be managed in the event of a blackout and therefore need to be brought into relation with each other. However, it also shows that formal status always plays a role even in the *ad-hoc* composition of case-related committees.

In the follow-up of the fact-finding committee, which worked on the issue for a period of 30 days (Corriere della Sera, N.N. 2003e), the senate authorized an "anti-blackout decree" which foresees simplified procedures for the construction of new power plants, new norms with regard to functionality and security of small power plants, and most importantly the merger of production ownership (Enel) and transmission (GRTN) in a joint society in which Enel cannot hold more than 20% after July 1st of 2007 (Corriere della Sera, N.N. 2003c). Minister of productive activities Antonio Marzano dismissed the accusation of the opposition of insufficient investment. According to him the construction of new power plants was ongoing and merely delayed by procedural disagreements over the direction that should be taken for this (Corriere della Sera, N.N. 2003d).

The concern over the security of the grids spilled over to Germany, however, where the speakers of various energy authorities engaged in a debate about investments into the German and European electricity grid (Bein and Büschemann 2003) as well as the question of how much wind energy the grid could tolerate (Vorholz 2003). Apart from a 380kV line in the French border area of Southern Geneva, the Rendissone-Albertville line, no disconnections were perceived in neighboring countries such as France or Austria (N.N. 2003d).

In the Italian blackout of 2003 several factors mentioned earlier played an important role for the re-organization of space. Firstly, the ineffective communication between the Swiss and Italian transmission system operator was critical because it reduces the importance of cross-border political-economic *regulations* by foregrounding the importance of *personal* communication between operative officials. Next, there is again the importance of locally organized tree

trimming and the re-organization of economic communities via the availability or unavailability of transmission lines (Switzerland-Italy, Italy-France, Italy-Austria). In the aftermath of the two disruptions (Mettlen-Lavorgo and Sils-Soazza) we can we can witness two shifts in relations within the political-administrative boundaries of Italy itself: the first is geared towards additional consumption and concerns the gain in importance of electro-intensive industrial and public facilities in Italy as well as energy consumers abroad as a means to stop the overloading of the grid via the increased consumption of energy at the beginning of the blackout event. The second is geared towards generation and concerns the foregrounding of additional generation facilities as a means to stop the drop in frequency that was caused by the interruption of several incoming lines and the lack of national production in Italy on an early Sunday morning.

**Europe 2006 blackout in Germany on November 4th 2003**

The blackout that occurred on November 4th in Germany originated in the human failure over the disconnection of a 380kV power line crossing the Ems river in Niedersachsen, Germany. Two days before the passage of the large cruising ship "Norwegian Pearl" the shipyard requested the disconnection of this river-crossing power line at the German transmission system operator E.ON Netz. This is considered standard operation procedure. E.ON Netz informed the neighboring operators and system stability analyses were carried out to guarantee that the system would be secure though probably highly loaded (Silvast and Kaplinski 2007a, 38). After this first request for disconnection the shipyard made another request with an earlier schedule for the passage of the ship. According to E.ON Netz the grid was secure at that point of the night. There was high wind feed-in both inside Germany, and from Germany both to the Netherlands and Poland, but despite that everything was normal. E.ON gave permission for an earlier schedule but only informed the neighboring operators at 19:00hrs. Unexpectedly, the load increase after the disconnection of the line generated an automated alarm signal and neighboring German operators asked for the re-establishment of secure conditions. The operators decided to couple the busbars at the end of the line to reduce current on it. Unfortunately this action had the opposite impact than was originally expected and resulted in an increase of the overload. As a consequence the UCTE system was split into three unconnected areas (West, North-East and South-East). The imbalances and the large frequency drop caused the large-scale interruption of electricity supply (Silvast and Kaplinski 2007a, 38).

The most affected countries were Germany and parts of France. Austria, Belgium, Italy and Spain experienced a few minor disruptions but overall the service was re-established quickly (AP 2006). To prevent a Blackout in Italy, the Italian system operators reduced the imports from abroad by 4.600 MW and increased the consumption by 2.100 MW thereby succeeding in keeping the system stable (N.N. 2006). Italian president and former president of the European Commission Romano Prodi criticized the fact that the countries of the European Union engage in trade with each other without having a single European Authority that is responsible for all these cross-border transactions and the associated exchange of information between the competent authorities (N.N. 2006). The Austrian Minister for Energy, Martin Bartenstein voiced similar concerns in an Interview with the German ZEIT. He requested that the European Commission take the reins on a single European Market for Energy; not least to remain competitive vis-à-vis the OPEC and Russia (Schmid and Vorholz 2006). Concrete actions would be the construction of further transmission lines between the members of the union as well as the boosting of national production, e.g. in Italy where generation is notoriously low and imports from France very high (Schmid and Vorholz 2006).

In the 2006 blackout originated on November 4$^{th}$ in Germany we can see how the passage of a cruising ship reorganizes the boundaries of the German electricity transmission grid. The failure to properly communicate the disconnection of a confined transmission line crossing the Ems river to other system operators and the ensuing neglect to reduce the amount of produced energy combined towards a blackout situation of enormous proportions. It is noteworthy that also a routine technical operation such as the routine reduction of electrical current by connecting a double busbar is subject to surprising turnarounds in particular cases: in this case the current was not reduced but additionally increased by the coupling of the busbars, which in turn resulted in disruption and additional *boundary-drawing* between the Western, North-Eastern and Sout-Eastern part of the UCTE system. Exemplary for the display of the concept of technological zones (Barry 2006) is Romano Prodi's statement that the European countries are materially and economically integrated with each other in the field of energy trade but that this integration is not adequately governed due to the lack of a joint European political authority. The example illustrates how agency in transnational electricity trade is badly served by the management of a plethora of national, subnational and transnational actors. An integrated framework regulating interactions among these is urgently needed.

**Interim conclusion**

In the present chapter I have asked a series of questions to the data set on eight major blackout analyses. The aim was to explore the relevance of the questions formulated along the theoretical synthesis chapter and to ground them in empirical material on transnational electricity governance. The interpretative commentaries on each of the blackout as well as the tables included in the annex deliver an explorative glimpse of the relations that exist between participants of *national* and *transnational* electricity governance systems and of how the hierarchy of those relations may be situatively reconfigured in the course of a blackout event. We can see from this preliminary interpretation that traditionally expected units of analysis of IR as for example *state* energy agencies, *private* energy companies or *technical* engineers do possess relevance in the governance of electricity. Nonetheless, the data also unveil a series of shifts in the *expected allocation* of authoritative *command* over the blackout situations.

These shifts include, for example, the re-organization of market relationships across countries or across different regions of one country, the re-distribution of agency away from the state government and towards the responsible private sector owner in the case of a single utility failure, the re-distribution of agency away from the private sector owner and back to the state government in the case of a systemic failure with potentially harmful effects for the national economy, the foregrounding of a specific utility over another one or over a group of other utilities, the overlap and negative coincidence between geographically distant transmission lines, the divergent value assessments that international company make of hydroelectricity under conditions of abundance and under conditions of drought, the necessity of integrated real-time information data over administratively separated geographical territories etc.

The interpretative commentaries and the tables show that these shifts are operated by the concentration or overlap of a series of human and nonhuman agencies in the situation of a blackout. They become visible to the external observer through the appearance of modified behavior of traditional governance units, the modified strategic focal points in the public debates and the recommendations formulated in the contingency reports of the appointed investigative committees.

From the perspective of transnational electricity governance, the actors and concerns that become foregrounded in a blackout event should ideally be covered by existing legislation and governance practices in order to prevent malfunctions in this critical sector of the economy and in others. Hence, the importance of transnational regulative bodies and regimes regulating the

situatively emerging technological zones must not be underestimated. However, we can see from the analysis of the selected documents that it is seldom possible to cover for all these interrelated aspects at once. Rather, is knowledge on the working of these critical systems bound to be fragmentary and even contradictory. The value of the presented investigation of blackouts is thus not to offer solutions on how to support the *objectivation* of knowledge or the smoothing out of contradiction. Rather does it reside exactly in the accentuation and awareness-raising vis-à-vis the myriad of punctual challenges that influence the contemporary governance of transnational electricity systems at present.

The detection of peculiar relations between the involved human and nonhuman actors on the basis of the blackouts is important as it allows me to specify the formulated empirical questions (chapter four) with regard to this field of the international political economy for the continuation of my thesis. On the basis of the explorative answers that I have put forward in this chapter (subsection on preliminary findings) I am now able to formulate a second set of questions that is more attune to the specific case of the planning and construction of the hydroelectric power plant of Garabi between Argentina and Brazil.

In what follows, I summarize the abstract preliminary questions and specify them with regard to their application in the upcoming case-study (chapter six).

The abstract empirical questions formulated in chapter four were:

***Q1.*** ***What are the individual entities that are involved in the transnational governance of energy?***

***Q2.*** ***On what basis can we designate the situatedness of entities to be local or global?***

***Q3.*** ***What are the sources of the reorganization of transnational energy regulation?***

***Q4.*** ***How do movements of association between human and nonhuman entities unfold in transnational energy governance?***

**Q5.** ***How does a technical object reconfigure centers of agency in transnational***
***energy governance? Which entities and relations are all of a sudden foregrounded?***

**Q6.** ***What are expected and what are unexpected reconfigurations of entities relations between human and nonhuman entities?***

On the basis of the preliminary results of the blackout analysis and the relation of these results to contemporary questions of transnational energy governance I make the following specifications with regard to the application of the questions to the planning of large electric utilities between several countries. The specifications center around four steps in the construction of a large electricity utility that I define as typical on the basis of my literature review of electricity utilities (Yeo 1995, Warkentin-Glenn 2006, Sim 2011) and my interviews with decision-makers in Argentina and Brazil. The phases are initiation, planning and design, execution and construction. Because every infrastructure project differs a little from this ideal-typical sequence a further specification is needed as regards the way in which I define the contents of each of the phases for my purposes. It is ueseful to keep in mind that the phases need not be strictly consecutive but may have *substantial overlaps as well as time-lags*. As Yeo reminds, the planning of a "large-scale infrastructure can be an arduous, protracted and iterative

process. A strategic long-term decision that leads to a desired outcome is not made easily" (Yeo 1995, 289). Under the formulated caveats (i.e. non-linearity of the planning process) I therefore understand these *idealized* process phases as follows:

Under *initiation* I understand those points in time where the idea of the electric utility emerges for the first time in public discussion. I then define the phase of *planning and design* as that phase in which organizational structures are set up and the contents and the design of the project are beginning to be explored. The phase of *execution* defines the phase in which the explorative planning becomes more concrete via the appointment of project teams and the issuance of inventory and viability studies. In the phase of *construction* the project begins to take concrete shape by means of contract tenders that are formulated by the contracting parties and offers by contractors. In these offers the project details are further specified and prepared for construction on-site.

**Initiation:**

- ***Q7. How is political agency constituted in the planning phase of a new binational electric infrastructure?***
- ***Q8. What are the elements and situations that emerge as significant in the planning phase of a transnational infrastructure project?***
- ***Q9. What are noteworthy shifts in the relations that are relevant for the planning of the electricity infrastructure?***

**Planning and Design:**

- ***Q10. What kind of adaptations become necessary in the organization of the knowledge needed for the planning of a transnational electricity infrastructure once the relevant elements and situations have been tentatively determined? What are the elements and situations that are represented in the organizational structure of the project? Which are left out? Why?***
- ***Q11. How is political significance attached to the elements and situations that emerge as relevant in the planning of a new electricity infrastructure?***

**Execution:**

- ***Q12. What kind of adaptations become necessary in the organization of the knowledge needed at the point where the electricity infrastructure project enters the phase of viability studies? What are elements and situations that are represented in this re-configuration?***
- ***Q13. What knowledge of this new organizational structure is used and what knowledge needs to be additionally created by the project team in order to commission the viability studies?***
- ***Q14. What are elements and situations that emerge as additionally relevant in the course of the viability studies of the project?***
- ***Q15. How is political significance attached to the elements and situations that emerge as relevant in the viability study?***
- ***Q16. What kind of adaptations in the relevant elements and situations of the project become necessary as a consequence of the viability report?***
- ***Q17. How does a specific enactment of an electricity infrastructure emerge after the viability studies have been terminated?***

**Construction:**

- ***Q18. What knowledge of the revised organizational structure is used and what has to be additionally created by the project team in order to commission the feasiblity studies for the project?***
- ***Q19. How are the offers of the contractors evaluated by the contracting parties?***
- ***Q20. What kind of elements and situations emerge as additionally relevant in the course of the call for tender for the feasibility studies?***

## 6. Qualitative analysis of Garabi

In the previous chapter I have used data on eight major blackout events from the last decade to assess the relevance of my theoretical questions and to formulate first tentative answers on how human and nonhuman actors intertwine in the constitution of an electricity systems. The need to carrry out this preliminary analysis is explained by my previous argument that electricity systems are conventionally hidden to us as they perform their tasks in the subgrades of architectural construction works, in pipes or cables, and electromagnetic waves (Star 1999, 380, Kaika and Swyngedouw 2000, 122). On the basis of the blackout analysis I have hence tried to make the functions of electricity systems more visible and to formulate answers regarding the multiple ways in which they are constitutive for all the processes of transformation that take place in society and politics (Kaika and Swyngedouw 2000, 120). On the basis of these answers (which are reflected in the theoretical questions of chapter four) I then formulated interpretative commentaries containing suppositions on how actors are reconfigured in a blackout event and used these suppositions to further elaborate my empirical questions with regard to their application in the case study on the hydroelectric power plant of Garabi (end of chapter five). The present chapter deals with those questions by presenting the results of my fieldwork in Latin America.

### Empirical method

### Case selection

To answer the list of infrastructure-related questions formulated with regard to the emergence of transnational electricity governance I needed to find an empirical case of the planning of a transnational electricity infrastructure that is both sufficently advanced but still *in-the-making*. Only in this way would I be able to observe the re-configurations that become necessary in transnational electricity governance on the basis of interplays between old and new infrastructures. I found this empirical case of a large technical infrastructure in-the-making in the large hydroelectric power plant of Garabi/Panambi, a run-of-the-river hydroelectric power plant to be commissioned by Argentina and Brazil on a shared intersection of the River Uruguay. The number of large transnational hydro power plants in the world is not enormous. The most important and renowned cases are all to be found in Latin America: the Yaciretá

power plant opened in 1994 by the countries of Argentina and Paraguay after ten years of construction. The Salto Grande power plant opened in 1979 by the countries of Argentina and Uruguay after five years of construction and the Itaipú power plant opened in 1984 by Brazil and Paraguay after 14 years of construction. The opportunity to study the re-organization of transnational electricity governance by means of such a transnational project in-the-making can thus be considered as rare and the example of the Garabi/Panambi hydro power plant as exemplary for the kind of research project I wanted to carry out.

Because doing interviews on ongoing planning processes, there is a lack of certified information as regards the initial phase of the Garabi hydro power plant. According to different sources , the beginning of the project can be traced back to the early or mid-1970s, when the state-owned Agua y Energía Eléctrica Sociedad del Estado of Argentina and the Brazilian national champion in power utilities, Eletrobrás, each supported by the actor-networks in which they are embedded, signed a binational[44] agreement regarding the exploitation of the shared intersection of the river Uruguay, approximately on the level of Garabi. At that point in time, two different locations for the power plant where considered: San Pedro and Roncador. These were however eliminated in 1988 when the first *basic project* of Garabi (proyecto básico Garabi) emerged. The "basic project" was formulated as a consequence of the 1980-treaty signed between the two countries and had its foundation in the "basic inventory studies"[45] that were carried out in the time span between 1986 and 1988 (EBISA 2011a). In what followed, however, the two governments withdrew from the joint planning commitment, leaving the project in oblivion for almost 20 years. It was not until 2003 that renewed interest in the project grew on the side of Argentina. A fresh binational[46] setup between Argentina and Brazil was subsequently signed in 2007 (EBISA 2011). A new environmental impact assessment was carried out between 2008 and 2010 as the environmental criteria of the 1986 study were not effective anymore (EBISA and Eletrobras 2010). In 2011, the joint executive organ of the two countries began with the set-up of the licitatory process for the construction works (EBISA 2012b). At the time of my fieldwork in Latin America in 2011 it was not yet clear whether construction works could start from 2012 onwards. This period from August 2011 onwards, however, falls outside the scope of this thesis.

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44 I use the term binational because I refer to the vocabulary of the treaty.

45 An inventory study is an assessment of the environmental impacts. Sometimes it goes along with economic viability studies. But the two can also be separated.

46 I use the term binational because I refer to a treaty signed by two states.

**Fieldwork**

The setup of my thesis was such that I have been studying a planning project in-the-making which is very far off my habitual daily routine both geographically and with regard to my professional training. Due to this fact and to the unfolding character of transnational energy governance, the character of my thesis can be described as explorative.

The explorative character of my case study favored the method of observing through interviews (Kvale and Brinkmann 2009, 3). This research method allows the actors who are directly involved in the planning process to convey their personal perspective on the project in a way that is more adequate for them than e.g. standardized questionnaires (Meuser and Nagel 1991, 454). I find this very important with regard to the assumption of multiplicity that dominates my research. Additionnally, the setup of face-to-face in-depth interviews with involved actors is consistent with the methodological framework of the 'sociology of associations' (Latour 2005) used in my thesis as it allows to trace associations that are not in themselves social but become such through the performance of relationships (Latour 2005, 5): as I have stated earlier, the inquiry into the knowledge backgrounds of each interviewee is an inquiry into the multiplicity of Garabi. During the interview situation, the interviewees are invited to narrate about their "often wild innovations, [about] what the collective existence has become in their hands, which methods they have elaborated to make it fit together, which accounts could best define the new associations that they have been forced to establish" etc. just as stated by Latour (2005, 12). In a similar evocative manner, Kvale and Brinkmann describe the method of in-depth interviewing with a metaphor of the "travelling researcher", who gets into contact with different people and participates in the emergence of their everyday life and realities through his or her conversation (Kvale and Brinkmann 2009, 3). In this vein, the semi-strucured topic guide with which I entered the research situation served as an orientation during the interview situation but left sufficient room for me to be responsive to the statements of the interviewees (Kvale and Brinkmann 2009, 130) with regard to their activity of "forming and dismantling groups" (Latour 2005, 29).

The topic guide for the semi-structured interviews in Argentina and Brazil contained the questions formulated at the end of chapter five. The time frame for analysis was open in the sense that I was investigating the events from 2003 until the summer of 2011. However, the interviewees were free to draw on any detail on the previous genesis and further development of the project as long as they could make the relation to the ongoing planning of the Garabi power

plant visible. On the basis of the interviewees' open-ended replies to my semi-structured interview guidelines I trace the constitution of a heterogeneous governance assemblage around the hydro power plant of Garabi and infer conclusions for the transnational governance of electricity between the two countries. The selection of the interview partners took place on the basis of another explorative content analysis, this time with focus on the Garabi power plant (see below). Additionally, further interviews were agreed on during fieldwork, this time following a snowball procedure. In total, I carried out 23 in-depth interviews that possess immediate connection to the Garabi project and its systemic surrounding between May 23rd 2011 and July 31st 2011. Moreover, six informal conversations with people who are not directly involved in the project of Garabi itself but can be regarded as experts of the national and international situation of Argentina and Brazil were carried out in the time span of field work. Before each interview situation, the topic guideline was attuned to the employment situation of the interviewee (field, position, education, competences) and his or her probable role in the planning of the Garabi power plant. In three cases the possibility of an oral conversation was not given due to the unavailability of the enquired interviewee and his or her unease to hold an expert interview in English. For these three cases, which concerned three Brazilian respondents, I prepared structured questionnaires and exchanged them with the experts via Email. The a priori adaptations to the topic guidelines and questionnaires were made on the basis of the explorative content analysis on the Garabi power plant. The following subsection explains the methodological cornerstones of this content analysis.

**Document selection**

In order to prepare myself for fieldwork I carried out a second explorative content analysis of newspaper articles and webpages covering the planning of the transnational hydro power plant of Garabi. I used the data gathered in this empirical step to determine the interviewees as well as to specify the contents of the interviews to be carried out with more empirical knowledge. Whereas the interviewees were free to refer their answers to the analytical time frames they would find most useful, I set a closed time frame for the preliminary content analysis that spanned the years of 2003, the year in which Garabi became of interest again for Argentina, until summer of 2011, the year when I was carrying out my fieldwork. Table 4 below exemplifies the selected newspapers. They were chosen on the basis of their highest circulation in the capitals of

Argentina and Brazil, the major economic cities of São Paulo and Rio de Janeiro, and the provinces that are involved in the project, i.e. Misiones and Corrientes in Argentina and Rio Grande do Sul in Brazil. The keyword for article selection was Garabi. In total 229 newspaper articles were selected and analyzed.

TABLE 4: NEWSPAPER SELECTION

| **Country/Province** | **Newspaper and city of origin** |
|---|---|
| Argentina (national distribution) | La Nación (Buenos Aires C.F.)<br>Clarín (Buenos Aires C.F.) |
| Argentina (provincial) | El territorio (Posadas, Province of Misiones)<br>El Litoral (Corrientes, Province of Corrientes) |
| Brazil (national distribution) | O Globo (Rio de Janeiro, RJ)<br>Jornal do Brasil (Rio de Janeiro, RJ)<br>O Estado de São Paulo (São Paulo, SP)<br>Folha de São Paulo (São Paulo, SP)<br>Correio Braziliense (Brasilia, D.F.) |
| Brazil (provincial) | Correio do Povo (Porto Alegre, Rio Grande do Sul)<br>Zero Hora (Porto Alegre, Rio Grande do Sul) |

On the basis of this preliminary analysis I explored a circumscribed number of webpages and electronic reports issued by the actors involved in Garabi and by the professional associations of the experts to be interviewed. Table 5 exemplifies the consulted webpages. A few of the interviewees also looked forward to discuss presentations and planning scenarios with me and previously sent me a limited number of restricted documents that allowed me to better understand the knowledge background of each of them. In addition, the interviewees also gave me further company reports and brochures to investigate in more detail. Since I did not use these systematically but rather selectively the documents are referenced where needed in the running text of the thesis.

TABLE 5: WEBPAGES

| **Association** | **Website** |
|---|---|
| EBISA (Argentina) | http://www.ebisa.com.ar/ |
| Ministry of Federal Planning and Public Investment of Argentina | http://www.minplan.gov.ar |
| CAMMESA (Argentina) | http://www.cammesa.com |
| CLICET (Argentina) | http://www.cienciayenergia.com |
| Edenor (Argentina) | http://www.edenor.com.ar/cms/SP/CLI/home.html |
| Transener (Argentina) | http://www.transener.com.ar |
| Metrogas (Argentina) | http://www.metrogas.com.ar |
| TOTAL (Argentina) | http://www.total-argentina.com.ar |
| Eletrobras (Brazil) | http://www.eletrobras.com |
| Ministry of Mines and Energy of Brazil | http://www.mme.gov.br |
| ABCE (Brazil) | http://www.abce.org.br/ |
| APINE (Brazil) | http://www.apine.com.br |
| ANEEL (Brazil) | http://www.aneel.com.br |
| CCEE(Brazil) | http://www.ccee.com.br |
| EPE (Brazil) | http://www.epe.com.br |

## Empirical results

### Vignettes

In presenting the results from my investigation I was greatly inspired by scholars working with 'vignettes'. As Van Wezemael, Silberberger and Paisiou put it: "The term vignette is used in ethnography to describe short, completed sequences. A vignette is not to be mistaken for a transcription (e.g. of a tape recording). It is in fact a re-construction of a situation based on the researcher's field notes. In that manner a vignette can be regarded as an adequate tool providing a clear and vivid description of the problem at hand" (Van Wezemael, et al. 2011a, 169). One of the applications of vignettes is given when no routine description of an investigated topic can be made. By describing typical situations and foreshadowing the possibility of combination and variation of typical situations towards an *emergent event* (e.g. transnational electricity governance), vignettes allow us to gain a general sense of the actor-networks that make up the emergent event under study (Orr 1996, 14). The method is widely used in European organizational studies where it is sometimes classified under the term of 'ethnographic fiction science' (Van Maanen 1979) because of its creative handling of qualitative ethnography and narration.

At present, the academic literature provides no fixed definition of vignettes. For this thesis I worked with a conceptualization of vignettes inspired by and discussed with (Silberberger 2011). Silberberger adducts Söderström's (2000) definition of vignettes as the most characteristical and writes (Silberberger 2011, 30, all emphases added):

> "Söderström describes his vignettes to be well-understood *fabrications* and *selections* of his observations that do not intend to *objectively* reproduce the observed situations. In my understanding a vignette is not a mere illustration stating the facts. Rather the process of constructing a vignette entails a *deeper comprehension* of what has been observed. Hence, constructing a vignette is part of the research process. Whereas a mere representation (or illustration) is separated from the process of research in the sense that it is solely used to communicate a completed interpretation of findings to others, constructing a vignette mirrors interpretation *in the making*. At the same time a completed vignette can of course function as an illustration".

Since I was allowed by the interviewees to tape-record most of my interviews, I decided to use the transcripts of that material to construct my vignettes. Despite the earlier reference to (Van Wezemael, et al. 2011a), I thus decided to use the exact phrasings of my interviewees (instead of using *only* field notes) in an attempt to better highlight and differentiate the actors, objects, places and temporalities that interact in the project of the hydroelectric power plant of Garabi. The understanding of vignettes that I use in the present piece of work is thus one of the researcher *searching*, *isolating* and *synthesizing* interview excerpts with secondary literature in a way that allows for a subjective interpretation of the investigated question of how technical electricity infrastructure intertwines with the social the technical and the political in Latin America and what this means for the emergence of a new transnational energy governance in the region.

I regard it as an open question whether each extract can then be regarded as a vignette or whether we must work on the assumption that the vignette comes into being by its synthesis with other extracts and the interpretative commentary. In either case, what I find consequential for my own definition and elaboration of a vignette in the present thesis is that the very search, isolation and synthetization of extracts mirrors my participation in a specific collective enactment of the project of the Garabi (Mol 2003). Within the overall 'conceptualization of the present thesis (c.f. specifically chapter four), I thus consider vignettes to be the appropriate solution to expound my analytical findings. The experimental method of constructing vignettes is coherent with the endeavor of actor-network theory to investigate the multiplicity of the social landscape and, by implication, the fragmentarity of knowledge creation. It is also coherent with my assumption that the creation of meaning takes place in a dynamic and interactive process of 'emergence' and that every testimony can only be situated in its precise time of enunciation since every later referral to it might be affected by new experiences and understandings" (c.f. Amin and Roberts 2008).

## Main empirical analysis of the planning and construction of the hydroelectric power plant of Garabi

In the present subchapter I present a series of vignettes for each phase of the Garabi project. I constructed these vignettes out of the synthesis of significant interview extracts and background knowledge gained from the study of secondary literature. The extracts are constructed around a particular situation that I find insightful with regard to gaining a more profound understanding of the transnational power plant of Garabi[47]. To present the vignettes I chose a procedure that is inspired by Orr, who first introduces the vignettes without explanation and then adds a commentary with necessary background information for the reader (Orr 1996, 14-15). As some of the extracts that I present can be regarded as self-contained they are immediately followed by an interpretative commentary of mine. On the other hand, I find it reasonable to present some extracts *in combination* so as to better highlight their *intrinsic relation* with each other and thus the *non-linearity* that we can witness in the transnational governance of the Garabi power plant. In this latter case I will thus introduce two to three extracts one after another and provide the aggregate interpretative commentary for these extracts only afterwards. Where I find it useful I will also provide links to further extracts of other project phases to stress additional non-linear interlinkages between the different vignettes. The emerging structure of the following subchapters is thus such that the reader can chose to follow the composition of extracts as it stands or he can decide to jump back and forth between interrelated extracts to gain a more realistic understanding of the governance of the Garabi power plant.

The elaborated 'map' of interlinkages between the individual extracts and vignettes is intended to be received as a social model of how the multiple and overlapping material developments, the social market rules and the political routines (i.e. situations of human-nonhuman interaction) around the infrastructure project of Garabi converged in such a way as to *co-produce* the political necessity of a transnational hydroelectric infrastructure.

To preserve analytical rigor I will follow the order of the four project phases of initiation, planning and design, execution and construction and the associated empirical questions (Q7 to Q20). The questions are especially answered in the commentaries to the extracts and in the conclusion. As a reminder, it is useful to note that I defined the four project phases on the basis of my literature review of the planning of electricity utilities (Yeo 1995, Warkentin-Glenn 2006,

[47] Inspired by Barry (Barry 2012, 7) I use the term of 'situation' as a means to move beyond any understanding of agency in transnational governance as 'caused' by isolated agents.

Sim 2011). To repeat: I define the phase of '*initiation'* as those points in time where the idea of the electric utility emerges for the first time in public discussion and before it enters a phase of more concrete planning. With regard to Garabi this covers the time frame before 2006. I then define the phase of '*planning and design'* as that phase in which organizational structures are set up and the contents and the design of the project are beginning to be explored. With regard to Garabi this concerns the phase when working groups and joint institutions begin to emerge around 2005 and 2006. Since it is not possible to make clean-cut demarcations, the phase of '*execution'* defines the phase in which the explorative planning becomes more concrete via the elaboration of terms of reference for invetory and viability studies as well as via the appointment of external contractors. With regard to Garabi, this phase concerns the period between 2008 and 2010. In the phase of '*construction'* the project begins to take concrete shape with contract tenders that are formulated by the contracting parties and offers by contractors. In these offers the project details are specified further and prepared for construction on-site. This phase is the least studied in this thesis because planning related to the construction was only beginning to unfold in 2011. As stated earlier, the presented extracts cover only the period until ca. August 2011. Also, depending on their personal perspective, the interviewees often talk about a "binational" plant of Garabi. I have kept this phrasing of the interview extracts because it pertains to the knowledge background of each interviewee. However, I have been careful to avoid this state-centric vocabulary myself and hence use the term 'transnational' in my commentaries.

## Initiation

As I have stated earlier there exists a lack of information with regard to the very early stages of the Garabi project, that is, from the early to mid-1970s. On the basis of the present thesis' case study research method, which sets its temporal starting point in 2003, it is however possible to make a statement about the situations that together have contributed to the revival of the hydroelectric power plant in Garabi after nearly 20 years of total neglect. The vignettes in this subsection thus elucidate the question of how agency was constituted in the initiation phase of Garabi. My empirical account of the (re-) initiation of the project identifies 16 extracts that illustrate concrete human-nonhuman interactions and thus give an idea of how the Garabi project emerged out of their convergence around 2003-2006. In particular, the extracts make visible that Garabi constitutes the point of crystallization of a variety of independent agencies.

**Extract 1**. *Interview with an Argentine manager of commercial energy planning at a large fossil fuel processing company on June 10th 2011. The interview extract deals with the status of gas in the Argentine energy matrix and its development from the years of the huge Loma de la Lata discoveries (O'Keefe 2007, 212) until Argentina's present day necessity to import liquefied natural gas (LNG) to cover the energy demand of its industry.*

I started to work in the sector in 1972. Therefore I could witness the period in which Argentina was a net importer of hydrocarbons because it did not possess a lot of gas. There was not much more gas than the one needed for household appliances of Buenos Aires. Argentina did not really consume a lot of gas at that time. But at the end of the 1970's we discovered a huge deposit of gas in Loma de la Lata. At that point in time it constituted the largest gas deposit in the world. It was absolutely incredible. At one single stroke this duplicated Argentina's gas reserves. This immediately triggered a whole process of substitution of formerly established energy sources with gas. And Argentina began to cover its demand in energy with gas to an extent of approximately 50%. The only comparable country who could do that is Russia, isn't it? Russia is the main gas producer. Thus Argentina carried out an extremely fast substitution of its conventional sources. Large parts of the electric system were transferred to gas: residential consumption, automobile production, all worked with compressed natural gas (CNG). Our main industries nowadays do not even consider the possibility of alternative sources, they all work directly on gas. A whole lot of sectors only consume gas nowadays. And what is more, Argentina also started what I term a real *boom* of gas exports. We constructed 14 gas pipelines. We designed them with an export capacity of 50 million $m^3$ of gas per day. – When Loma de la Lata was only able to produce 30 million $m^3$ of gas per day! Loma de la Lata! The largest gas deposit in the world! Obviously, the situation started to deteriorate very quickly on this basis. Our reserves were quickly reduced to an outlook of 30 or 40 years, in its reserve-production relation. And this amount decreased daily, according to what we were consuming and exporting. At some point our reserves only amounted to six or seven years! Not only Loma de la Lata was in decay also our other deposits in Neuquén, which is one of Argentina's principal locations for gas deposits. As a consequence we were forced to import more every day. Around 20% of our demand in energy is being imported at the moment. This is a recent trend. But to be honest this process comes from earlier in our energy history.

**Commentary.** The presented extract addresses the *situation of a gas crisis* in Argentina. If we take a look at this first extract three shifts in human-nonhuman relations become clearly visible. The first shift concerns the configuration of the Argentine energy matrix at the beginning of the 1970s and at the end of the same decade. Previous to the discovery of gas in Loma de la Lata Argentina covered its demand in energy through the import of petroleum. The discovery of huge gas reserves at the end of the decade prompted a shift in energy consumption in the sense that gas was introduced as the main energy supplier in the gross of residential and industrial applications in the country. The geography of energy supply changed at once: as a second perceptible shift in the energy landscape of Argentina several new gas pipelines were constructed, among these 14 for exclusive use in export transactions. Loma de la Lata became the main source of supply for a plethora of consumption nodes in the Argentine electricity system and abroad. The design of material export infrastructure mirrored the importance of the incipient market relationship with the world: despite a production limit of 30 million $m^3$ of gas per day in Loma de la Lata the pipelines were constructed to serve a growing exploration and export volume and therefore up to 50 million $m^3$ of gas per day. Concomitantly to the construction projects, however, the discoveries were starting to drop. As a consequence of the gas exports and the immense levels of national consumption the geographies of Argentine energy demand experienced a third shift: from one of the main gas *exporters* of the world, Argentina returned to be a net *importer* of gas, thus sensibly affecting its state economy via the discrepancy between the high prices for gas paid on the world market and the low prices that could be enforced domestically.

**For further investigation into the interlinkages between the gas crisis and other situations the reading of extracts 2, 3, 4, 8, 11, 15, 16, 17 and 18 is recommended.**

**Extract 2**. *Interview with a former Argentine manager of high voltage transmission that is now working as an independent consultant for energy planning and investment. The interview took place on May 31st 2011 and this extract focuses on the need for professional expertise to construct civil engineering projects from the realm of hydro power planning. The interview addresses especially the period of the 1990 until 2000 when the Argentine energy planning was still under the spell of the huge Loma de la Lata discovery.*

We are lacking a whole cohort of 15 years in the branch of electric and hydroelectric engineering. A whole cohort of young professionals simply does not exist.

*– And you are employing foreign professionals to cover for this lack of expertise? Professionals from Brazil or from elsewhere?*

What I am doing is to train my own people. I am doing this in two of my projects currently. It's a lot of people I am educating.

*- How do you preserve the knowledge that is generated. You possess a lot of knowledge that however is constantly changed and adapted in the process of transmitting it. How do you assure the quality of your education over time and across so many people?*

This is very difficult to answer because you know: people are *made*. I have a saying that you might know. It that states that you may have an excellent university, an excellent professor, but if you do not have streets and bricks – streets go your way and bricks not to sink in... Bear in mind that the famous universities of Harvard and other ones in the U.S. create infant prodigies. But the infant prodigies we need for this very specific work here in Argentina, for transmission and generation in our degree of latitude, necessitate situated knowledge. They need practice. In my opinion the Argentinean engineer might not possess the same excellent educational background as the American. The U.S. engineer might possess more formal knowledge. But the Argentinean is bound to possess universality. He might only come second to the U.S. engineer in formal technical knowledge but in the universality of directing a long-term project I would rather conceive the hierarchy the other way round.

**Extract 3**. *Interview with an Argentine high-ranked technical manager in the Argentine energy trader on May 27th 2011. The interview extract focuses on the decline of technical expertise for hydro power planning in Argentina. It sketches a situation of competition for engineering professionals working in the Southern Cone markets and corroborates the good reputation of Brazil for innovation in engineering.*

Hydroelectric power plants require a distinct practical training. It's not about the title. It's about practice. While Agua y Energia Eléctrica was functioning there were lots of people working on the branch. It is a branch that is very different from the rest of civil engineering. It's highly multidisciplinary. You need to be able to work in a collective with civil engineers, electrical engineers, electricians.... In the organizational structure that I established here I have hired mature professionals aged 65 and older because they possessed experience in the field of hydro power plant construction and they could help me to evaluate the experts' reports. But every day there is more demand. Especially in Brazil that is expanding its share of hydro everyday. Three of

the experienced professionals I had hired ran off to Brazil because of this. And some of them were from the Dominican Republic. There are not sufficient professionals in Argentina. And as I said, Brazil is swallowing them all. They have many projects all over the world. Even in China. And so the few professionals there are very difficult to get hold of.

- *What do you do about this problem to still be able to manage your project?*

This is exactly the problem. In general, the people who work with me are sent out to do a lot of fieldwork. We have morphed more into tutors, professors, into coaches. Our young employees need to understand what we require for this project. This will also help them personally. But well it is not the ideal path, merely what one 'can' do. I dedicate a lot of time to this task.

**Extract 4.** *Interview with an Argentine high-ranked technical manager in the Argentine energy trader on May 27th 2011. The interview extract focuses on Brazilian technical innovation in hydro power planning.*

Today if we look at the market, Brazil is the one who has the most experience in hydro. They export technology. They have displaced the European market - both American and European companies. Brazil gathered a lot of expertise in the last years because they were the only ones who persevered in constructing hydro when the others stopped because of environmental reasons. Brazil kept going and that's why they have experience today.

**Commentary.** The presented extracts address the labor market situation in Argentina and Brazil in the aftermath of the Argentinean gas boom. They center specifically on the *availability of expertise in electrical and hydroelectric civil engineering*. If we look at these three extracts we can see how the shift towards gas in the Argentine energy market corresponded with a shift in the labor market of the country. The interviewees comment how the gain in importance of gas sources affected the expertise of electric engineers in Argentina. Due to the Loma de la Lata discoveries, the construction of gas facilities, gas-processing household appliances and pipelines for transport were further expanded under the Menem government. As O'Keefe states, "by 1997, natural gas supplied almost half of Argentina's energy consumption needs, and the country became the third largest user of natural gas in the world, after the United States and Russia" (2007, 219). According to the two interviewees, one of the repercussions of this boom in gas was that electrical and civil engineers in Argentina lost the possibility to hone their skills in areas of electricity generation other than gas, and in the field of electrical transmission. The importance of

field work in the training of civil and electrical engineers is emphasized in all three extracts. As a consequence of the reduced activities in hydroelectric construction and electric transmission, both managers are therefore investing significant effort in a close coaching of the young professionals they hire for their projects. Concomitantly, this lack of homegrown professional leads to a re-evaluation of more mature professionals for business processes: as trained professionals from the realm of electricity transmission and hydropower construction suddenly represent a rare group, their value on the labor market increases. However, because of the infrequence and specificity of their skills, the hiring of trained professionals in the two discussed areas has the potential to create delays in the project schedules (e.g. long job vacancies, close follow-up of unskilled professionals) or to inefficient cost allocations in staffing. Hence, from the point of view of both interviewees it makes sense to invest additional effort into training young domestic labor forces and build up expertise for upcoming projects. This individual assessment becomes additionally corroborated when we read extract four and learn about the international labor environment in electrical and hydro engineering. In extract four the interviewee provides another reason for the decrease in hydro power planning, which he situates in the emergence of sustainability regulations. According to him, the slowing down of hydro power planning in Argentina can also be read in relation to this fact, which he finds to have been disregarded in Brazil. Apart from this situation the lack of homegrown professionals and the sustained education of such professionals in Brazil however led to a shift in the international labor market. Knowledge transfer begins to take place across the borders of the political-administrative units such as Argentina and Brazil and even the U.S.. From a general point of view these knowledge transfers may be problematic because foreign professionals inflate prices on the one hand and on the other hand affect domestic labor markets because of the *brain-drain* problems associated with it. However, with regard to the planning and construction of the transnational hydro power plant of Garabi the Brazilian expertise acquires a critical type of relevance in the sense that is difficult to conceive that Argentina would have been able to carry out such a project without the support of an experienced partner as Brazil.

**For further investigation into the interlinkages between the labor market situation in Argentina and Brazil and other situations the reading of extracts 1, 12, 13, 14, 19, 24, 25 and 26 is recommended.**

**Extract 5.** *Interview with a renowned Argentine economist and intellectual on June 1st 2011. The interview discusses corruption and administrative mismanagement in the Argentine economy with specific focus on the Kirchner administration (both Néstor and Christina Kirchner).*

Look at this, I recently finished a statement of condition with regard to the investments in the Argentine energy sector. The whole sector is in decay. Petrol, gas, investments in transmission... We are talking about 150'000 millions of dollars that are missing. It's difficult to think of such a number. I cannot think of such a number.

Mrs. Kirchner went to Qatar in January and when she was back she announced that Argentina would import liquefied natural gas from Qatar because this is a commodity that we will convert in aggregated value over here because we are industrialized! They did not tell Mrs. president that we are importing because our own production here is in decline! And why is that? Because the reserves are in decline. And why are the reserves in decline? Because they are not being explored! In the 1980s Argentina made 100 wells for petroleum exploration. In the 1990s we made 98. In 2010 we made 26!

- *What is the reason for this change?*

Two reasons. First because the concessions for petroleum exploration that were assigned in the last years were given to people who are not in the petrol business. They are all friends of the Kirchner government: Lázaro Báez, Cristobal López, the Manzano-Vila group. None of these guys invested a cent in the business. They take over the fields and see if they are able to do business out of it. They resell them. And the second reason is that the Argentine company Yacimientos Petrolíferos Fiscales (YPF) extracts all the reserves and does not replace them. They do not invest in additional exploration. The reason is that the Spaniards from the bank Caja de Cataluña sold 25% of the shares of YPF to the Petersen Group, another financial group that is personal friends with the Kirchner family. So these people bought 25% of the YPF shares without investing a single cent. They bought it with a credit from the same Caja de Cataluña which they would safeguard with liquid dividends of the company (YPF). The group committed to defer 90% of the stock dividends in cash. If a company does that, tell me how it will continue to make investments? None of the petroleum companies uses more than 30 or 40 % of its stock dividends to defer its debts.

**Commentary**. The present extract addresses the situation of allegedly *corruptive practices in the state administration of Argentina*. If we look at this interview extract we can witness the

mismanagement of state securities under the Kirchner administration. Instead of conducting serious investments, the Kirchner administration redistributed the state revenues among its so-called 'friends'. According to this interviewee and to current debates in Argentina (Di Mattero 2009) the decline in state investments in petroleum exploration is heavily influenced by the corrupted practices of the current government. From this point of view, the limited number of reserves is not due to their effective depletion or the absence of state money. The disinvestment is due to the reallocation of revenues outside the circuit of state treasury, which makes significant state investments impossible.

**For further investigation into the interlinkages between alleged corruption in Argentina and other situations the reading of extracts 6, 7 and 8 is recommended.**

**Extract 6**. *Interview with an Argentine pricing manager at one of the large electricity distribution companies in Greater Buenos Aires on May 30th 2011. The interview extract focuses of the electricity pricing in Argentina. According to this manager electricity production in Argentina is not sustainable at all.*

Today, the residential client does not see the actual price of electricity. The residential consumer pays a low consumer tariff. He pays 15 cents for the energy that actually costs 150 cents to produce. He consumes energy that he is in reality not able to afford. Therefore some other client is forced to pay a differential price because otherwise the system does not 'work out even'. For the state the costs of energy are very high. That is the part of energy imports and the subsidies are very high. This creates a huge leakage in the state treasury.

The problem is that we have the elections coming up soon. They will not find the political resolve at this point of the political agenda to put things straight and increase the tariffs for residential consumers because this would be political suicide.

Nonetheless, the decision to construct new utilities depends on the state. It is the state that determines further investments and sanctions them. He is responsible for mounting the investment. But new investments are costly and at present the state tries to cover for these new investments by freezing end-user rates for electricity while at the same time forcing the industries to reduce their demand. They apply very high monetary fines to the industrial factories who do not commit to energy rationing. That's how they save millions of dollars instead of investing them in new utilities. And if they still implement a new generation plant they apply the

differential cost, that is a higher cost per consumed energy, to the industry only. Not to the residents.

**Extract 7.** *Interview with a high-ranked energy planning official of the Ministry of Energy in Argentina on June 8th, 2011. The offical explains the advantages of a hydro-power plant vis-à-vis other power plants in the overall economic context of Argentina.*

A combined-cycle plant is installed very quickly. It's firm energy. Very cheap in capital investment, compared to hydraulic power plants. And as there was abundant gas, the price for the cubic meter was very cheap in Argentina. This was basically the best of possible worlds but we were living under conditions of surplus supply.

Therefore, I would say that there is an internal necessity in Argentina to diversify the energy matrix, not only for environmental reasons but also for intrinsic necessity, no? For this reason, in this new context, some hydroelectric power plants with good economic conditions are planned in convenient areas. A hydropower plant is not a model kit. Its capacity varies on the basis of natural conditions. I mean hydrological conditions, closure conditions, and others. It's much more complex than a combined cycle plant. But well, it helps to diversify the matrix. So I believe that the government has started to send the first positive signs, to start to… even we here together with the authority entrusted of Garabi are pushing to get the whole technical 'paraphernalia' for the different studies to be made. New studies of hydroelectric power plants together with the archived ones of earlier studies that we had already made. We put the former studies on the desk, made a first selection of 30 possible hydroelectric constructions and then selected 12 of those were we thought that they would be the most successful and those on which we possessed the most information. We homogenized the selection with regard to how to evaluate them and so of the 12 we had originally selected there remained 5 that seemed reasonable to be promoted. One of these is Chihuido 1, which is currently put out for tender. The other one is Río Santa Cruz – which is also a very political issue – and it is also currently put out for tender. But concomitantly the government has tried to push forth agreements with the provinces where the plants are located. This means that we are aiming at agreements with the provinces in order to establish a more long-term plan for the hydro power plants; one that encompasses the whole country. In this regard we have to talk first about national projects, not binational ones like Garabi. Because Garabi is on a whole other path, it is designed to have around 5'000 MW at the very beginning, 5'000 MW that can be successively expanded to 8'000 MW.

**Commentary**. The presented extracts address the *practices of electricity pricing in Argentina*. If we look at the first extract we can see how the residential consumer and elector is favored by the energy politics of the Kirchner administration. As we can see from the extract, the populist moves of the president, specifically his freezing of the end-user fees and compelling of industries to reduce their demand (c.f. also O'Keefe 2007, 212), undermined the incentives for private investments of energy firms in exploration, expansion, modernization of resources and infrastructures because their revenues were left untouched while their overall costs were increased (O'Keefe 2007, 212). Until today, the Kirchner government is following the same populist policy of pleasing the poor populist voters while discriminating against efficient market players. This policy has seriously damaged the reputation of Argentina as an investment location. (Di Mattero 2009). On the basis of this exposition it is interesting to look at the next extract. Here we can see particularly well how Argentina has been affected by the gas boom and by the mismanagement of the energy sector in the 1990s and 2000's. The interviewee of extract seven explains how Argentina is now in urgent need for cheap energy and that this is a reason for the current rise in hydro projects in the country's energy portfolio. Despite the high initial investment costs, energy production cost of hydro is fairly low afterwards; always bearing in mind that environmental and geological conditions might cause the plant to be affected by underproduction due to low rainfall, inclination of slope, closure of the power plant etc. Additionally, what we can also see from this extract is that transnational power plants experience a differential treatment with regard to their function of diversifying the energy matrix. Indeed, the Ministry of Energy has long inventoried a selection of around 30 (national) hydro-investments in advantageous provinces of Argentina (each of which produce around 1'000 MW). However, the officer stresses that these projects need to be distinguished by "binational" ones like Garabi/Panambi, which are planned to carry much more installed capacity. Though the numbers to be found in the planning documents vary still, it is safe to say that the energy produced between the two plants in Garabi will lie somewhere between a minimum of 2'200 and 5'000 MW. On the basis of informal conversations with other interviewees and my study of secondary literature on the topic, I would add that another distinction to be made between Garabi and national hydro plants is that as an international project Garabi is eligible for funding by international development banks as the IADB or the BNDES, which would ease the strain on the Argentine treasury considerably.

**For further investigation into the interlinkages between the practices of electricity pricing in Argentina and other situations the reading of extracts 5, 8, 17, 30, 31 and 32 is recommended.**

**Extract 8.** *Interview with an Argentine senior scientist working at the intersections between social science and electrical engineering on May 23rd 2001. The interviewee has worked as a consultant on the Garabi project at the Argentine Secretariat for Energy in 2003 and is now sporadically engaged in working groups at the same institution. During his Garabi-related mandate the senior scientist was appointed to the investigative committee entrusted with investigating the risks and benefits of the Garabi power plant project. The presented interview extracts focuses on the revival of the Garabi project in 2003.*

This started with Kirchner. With Kirchner and Lula. The two guys created the best relations between Argentina and Brazil. With both presidents. Of course with their faults, defects but also their successes. But they can be credited both. Both presidents.

- *And you were working on the Garabi project as early as 2003? For the Argentine Ministry of Planning and Public Investment?*

Yes. The Secretariat for Energy knew that they would have to push their engagement forward. I mean, when you take the resolve to continue with the construction of a hydroelectric plant and you decide to do it with another country because the other country also possesses rights on the river you cannot say: "come on, let's start doing this project together. No before you make your offer you study the project on your own. And this what I was hired for in May 2003.

- *The month when Kirchner took office?*

That same month I was called by the Secretariat for Energy. You know, it's not that Kirchner united with his cabinet and that they offered him a menu for utility investments. No! Kirchner was forming his ideas on the topic while he was presidential candidate. He must have been planning his government 'oeuvre'. And he didn't tell anyone. He simply laid a trail so that the people would elect him.

- *The project of Garabi was not on the agenda of the former government?*

No. In 2002 we had Duhalde. This was an interim government. But Lula and Kircher were two presidents who had as their personal aim to develop their people. Their economies. And their selected path was one of industrialization in the context of regional integration. They took Europe

as an example. Coal and Steel. Industrial and energy integration. Today Argentina and Brazil are materially and economically connected via its electricity grids.

**Extract 9**. *Questionnaire filled in by a Brazilian manager of energy production at a large Brazilian electricity producing company. The argument of the manager focuses on the incentives that his company had to engage in the planning and construction of the Garabi hydro power plant.*

The development of the water resources on the shared intersection of the river Uruguay are not merely a technical and economic opportunity. In this they are different from other hydro projects of our company. The development of water resources on the river Uruguay also depends on the will of the Brazilian and Argentine government.

**Commentary**. The presented extracts address the linkage between the planning of Garabi and the political will of incumbent presidents. If we look at the first of the two extracts, we can observe how the senior scientist foregrounds the concern with economic development in Argentina. In order to fight a further economic backslide after the energy crisis of the 1990s and the ensuing economic crisis at the beginning of 2000, the relevance of cheap energy is increased. Notably with regard to supplying the industry with it. By implication, the project of the hydroelectric power plant of Garabi becomes newly attractive as hydro figures among the cheapest sources of energy together with nuclear and gas. As a second shift we can observe the increased momentum in the relationship between the two neighbors Argentina and Brazil. In a mutual interest to propel their economies forward, and under a similar energetic strain (gas vs. hydro crisis, c.f. extract 11) the potential of an alliance emerges as the potential solution for financing difficulties in the realm of energy infrastructures because the burden of the planning and construction may be shared. By considering extract 9 we can see how this political-ideological momentum stood in disagreement with the economic assessments at the involved energy production company in Brazil. The sudden prioritization of the Garabi power plant on the political level overturned the economic investment priorities of this market player who would not have invested into this project as the first possible option.

**For further investigation into the interlinkages between the political will and other situations the reading of extracts 1, 5, 11, 12, 13, 14 and 15 is recommended.**

**Extract 10**. *Interview with a high—ranked official at the Ministry for Energy in Argentina on June 8th 2011. The interview extract highlights the importance of existing transmission lines and converter stations in the land corner situated around Garabi.*

There is already an interconnection between us and Brazil. The most important one in the Americas with regard to transport capacity, except for the one between the Unites States and Canada,

- *To which line do you refer?*

I refer to two connections. One is Garabi 'proper', the substation… I have to put it differently: close to Yaciretá there is a very important substation called Garabi from where two lines of 500kV each depart, each has a carrying capacity of 1'150 MW and there is no other example with these characteristics in Latin America and the Carribbean. In reality, this project obeyed the rules of the game of the 1990s, that is the necessity to export. And later there was the gas problem. But further lines are being constructed and there are important spot interchanges at the moment. They could be more important but they are quite important already between Argentina and Brazil.

The lines are these ones (shows CIER map). The most important substation is Garabi. At heart this is what Garabi actually is. Garabi is the name of this particular spot on the map. Here are the two lines. Rincon de Santa Maria, where you have the transformer station of Yaciretá and then you have two lines that cross the north of the province of Corrientes, almost at the limits with the province of Misiones. They cross the river Uruguay. This is an important station on the Brazilian territory. As they have a different frequency, there is a transformer station. And its name is Garabi.

**Commentary**. The presented extract addresses the *technical ease* with which the new hydroelectric power plant of Garabi can be integrated into the electricity grid thanks to its convenient technical location. In this extract we can see how the construction of the *substation* of Garabi, which dates back to the late 1990's, is still unfolding its influence on political decision-makers and involved peoples. Through its very existence and the existence of several transmission lines the substation creates an economic and technical bond between the suppliers and consumers of energy of Argentina and Brazil which can easily rotate their roles. The material integration that is operated between Argentina and Brazil via the substation and the transmission lines favors intentions to incorporate further generation in that corner of the continent because only few adaptations to the grid become necessary. In this way, the substation modulates the

relationship between Argentina and Brazil in such a way as to foster the tightening of relational bonds between them. This cultivation of relational bonds in that corner of the continent is interlinked and additionally supported by another transnational hydro power plant. This time the one constructed between Argentina and Paraguay: the Yaciretá power plant. This plant is also coupled to the Garabi substation and its related transmission lines. Technically the dense interweavement of generation units and transmission lines proves an additional support for the technical reliability of the transmission capacity in this spot. Both economically and technically, the Yaciretá power plant and its related lines integrate the country of Paraguay into the emergent assemblage of a dense and reliable regional electricity grid.

**For further investigation into the interlinkages between technical factors and other situations the reading of extracts 15, 35 and 36 is recommended.**

**Extract 11**. *Questionnaire filled in by a Brazilian manager of energy production at a large Brazilian electricity producing company. The argument of the manager focuses on the changes in the Brazilian energy market from the 1970s onwards. He perceives these interrelated changes as having contributed to Brazil's turnaround in energy generation and supply.*

In the 1970s, the Brazilian economy, and specifically the electricity sector was ruled by the model of the state entrepreneur in which practically all the investments were made by the state. Our company merely had an important role with regard to sectoral development. This involved activities of planning, investment decisions, the operation of utilities and transmission grids as well as the distribution of energy. In the following decades Brazil however experienced similar development tendencies as the rest of the world.

From the 1990s onwards, the electricity sector started to be governed by market economy principles. A regulatory agency the CCEE was established and a process of utility disintegration including generation, transmission and distribution started. An independent transmission system operator, the ONS was established. The tendency went towards 'minimal state involvement'.

At the end of this decade, a generation crisis occurred and with it the awareness arose that some minimal involvement of the state would still be necessary. After the turn of the millennium, Brazil established a new sectoral model. In it, among other things, the market economy principle was maintained but state regulatory mechanisms were introduced with regard to energy generation. This was made through interrelating the bidding of concessions with long-term energy vending contracts. In this period the Energy Research Corporation (EPE) was also

established. It is responsible for supporting government decisions on medium and long-term energy planning. Through these reforms we achieved substantial progress in institutional stability which was notably well received by private actors, who increased their investments in the sector. Today we have more than 60% of new assets.

**Commentary**. The presented extract addresses the *mismanagement of the energy sector* in Brazil and the *processes of reform* undertaken in the aftermath of the energy crisis. If we look at this extract we can observe several shifts in the organization of the Brazilian economy that can be regarded as stemming from earlier infrastructure decisions taken under the earlier military regimes (until approximately 1985 in Brazil) and new federal republics (1985 onwards). These earlier decisions prompted for example a shift to the market economy. Independent regulators were introduced to reduce the levels of corruption and increase the level of economic efficiency in infrastructure projects related to electricity. However, the fast liberalization later prompted concerns that private actors would merely maximize their individual economic efficiency and it was therefore recognized that a certain circumscribed form of holistic state supervision would nevertheless be needed in order to guarantee a reliable supply of energy under conditions of a growing economy. From then on, the state gained renewed relevance in the Brazilian energy market. It intervened in decisions regarding the construction of utilities in order to safeguard a sensible mix of resources in the composition of the energy matrix. However, this renewed inclusion into technical matters of infrastructure planning called for additional expertise in both financing, utility planning and related areas. The state was thus forced to abandon some parts of its direct authority and distribute it in the wider public and private sector where appropriate expertise for certain decisions could be gathered. For this the Energy Research Corporation (EPE) came into being. It responded to the need of the government to learn more about middle- and long-term planning in the electricity sector. A formerly important state enterprise from the realm of power production kept a few of its responsibilities, notably its expertise to evaluate the market's acceptance of certain investments. However, its relevance was significantly reduced compared to the time when it formed an integrated part of the state (state ownership). As a fourth shift in the hierarchies among different agencies in transnational energy markets, all these interconnected developments created an attractive investment environment for foreign companies. The geographies of multinational corporations began to shift as they discovered the chances for profit offered by Brazil.

**For further investigation into the interlinkages between the mismanagement of the energy sector in Brazil and the ensuing reform processes with other situations the reading of extracts 1, 8, 9 and 15 is recommended.**

**Extract 12**. *Interview with a senator of the state Rio Grande do Sul on June 29th 2011. The interview turns on the friendly diplomatic relation that has emerged between Argentina and Brazil in the last decade.*

Ever since we first started to talk about hydroelectric power plants in the region, that is since more than 20 years, when Itaipú was also constructed, Garabi was already being publicly discussed. This is a discussion, a project that dates very far back. I would say that this discussion was delayed because the relation between Brazil and Argentina was not very close at that time. This has changed considerably in the last years. But before that the two countries did not intermingle much. Argentina gazed at us in distrust. But nowadays a series of hydroelectric power plants is situated on the river Uruguay and this is just one more. In Rio Grande do Sul it is a concern that 12'000 people will have to be dislocated because its lands will be affected by the flooding. However, I cannot find any major organizational problem in this process. This will be a guided process. We had a bigger problem when we decided to construct Itaipú. The plant that we constructed with Paraguay raised concerns about the volume and the force of the power plant's water reservoirs and about the prospects that these qualities could be converted into a weapon against Argentina during a war. If the power plant would break a huge flooding of the Buenos Aires area would have been the consequence.

**Extract 13**. *Interview with a high-ranked official at the Brazilian Ministry for Mines and Energy (MME) on June 30th 2011. The interview extract focuses on the Brazilian interest for regional energy integration with Argentina.*

Geopolitical reasons. Brazil is growing by approximately 4.5 to 5 % per year. We included around 13'000 Brazilians in the economy in the last 10 years. That is 13'000 Brazilians that were jobless before. The buying power of Brazilians is increasing steadily. Now what do you expect from the neighboring countries? That they look at how our economy is growing while theirs is perishing? No, thus all that Brazil can do to produce win-win-situations in the region is to offer participation.

- *Participation?*

Business. The fact that two countries do business with each other is good for both countries. Why shouldn't we do that. Brazil has a legitimate interest in the economic development of Argentina. Not only of Argentina. Also of Uruguay and Paraguay. For Brazil it is important that these countries develop further economically.

**Extract 14**. *Interview with a senator of the state of Rio Grande do Sul on June 29th 2011. The interview extract explains the economic and developmental relevance of the Garabi hydro power plant for the state of Rio Grande do Sul.*

The power plant of Garbi has been under discussion ever since. Now they seem to have reached an agreement that allows for the starting of construction next year (2012). For the state of Rio Grande do Sul this is an important project with enormous trickle-down effects towards the region. The Eastern region of Rio Grande do Sul is a traditional region, a historic one where two presidents of the Republic where born (Getúlio Vargas and Hermes da Fonseca), where we have venerable cities (Uruguaiana, Livramento, São Borja). But now it is a backwardish region. It is a traditional livestock region that suffers a regime of impairment. Therefore I consider that the construction of this power plant is in the interest of the region.

**Commentary.** The presented extracts address the concern with *regional diplomatic relations* from the point of view of two Brazilian interviewees. If we look at extract 12 we can see how the cooperation between the military governments of Paraguay and Brazil is compared to the non-cooperation between the military governments of Argentina and Brazil. While Itaipú was constructed, and thus a shift in the qualitative relation happened between the two countries, it must have been feared by Argentina that they would facilitate a Brazilian siege if they had accepted to engage in infrastructural development in the corner of Misiones. After all, Brazil was regarded as a powerful military regime at that time. Thus we can observe how the fear of foreign infiltration by Brazil was regarded as mediated by the construction of a joint infrastructure in Garabi and therefore it appeared safer to abandon the project. Nevertheless, also the construction of Itaipú between Brazil and Paraguay created security concerns in Argentina. However, they were such that they could not object to them unless by renouncing to create an additional security threat with the construction of Garabi. Under contemporary political circumstances these fears are long gone and the image of a hazardous destruction of Buenos Aires has been replaced by images of increased prosperity for this region and beyond. Indeed, the planned construction of

Garabi is also expected to change settlement patterns and labor markets of 12'000 people in the state of Rio Grande do Sul. The concerns of the second interviewee in extract 13 are intrinsically related to the forecast of economic prosperity in the region. According to this official the joint hydro power plant in Garabi has the potential to contribute to the flattening out of the economic differences between the countries of Argentina and Brazil. Economic welfare shall become a characteristic of the region not of an individual country. For Brazil it is more profitable to invest in the construction of a hydroelectric power plant that they do not 'actually' need (because for them it would be more sensible to diversify the matrix otherwise c.f. extract 9) than to become the haven of welfare and a huge attractor of rural and urban economic migrants from the surrounding national economies. Extract 14 adds a differentiating statement to the declaration of the MME official. We are able to consider, how the construction of the Garabi power plant also mediates a change within Brazil, that is within in the production structure of the state of Rio Grande do Sul. For several decades this state has remained in the background of economic relevance for Brazil because it is a predominantly agrarian state. The construction of Garabi provokes the possibility of enlivening the labor market by attracting skilled labor, the necessity for interrelated infrastructure and employment in housing, hospitals, schools, retailing, police and fire departments etc (EBISA and Eletrobras 2010). By means of all these interrelated changes the development of this traditionally backwardish region is modulated. And by implication, there is an ideological upgrading of a historically important region which is interpreted by the senator as a symbol of national arrival.

**For further investigation into the interlinkages between regional diplomatic relations and other situations the reading of extracts 2, 3, 4, 8, 9, 15, 16, 17, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35 and 36 is recommended.**

**Extract 15**: *Interview with the head of one of the regulatory departments in one of Brazil's regulatory agencies on June 24th, 2011. The interview extract focuses on the importance of the Garabi substation for the Argentine-Brazilian economic relationship.*

The history of the Garabi converter station started in 1997 because of the necessity of Brazil to buy energy from Argentina. Brazil needed energy and Argentina had an overcapacity. Thus the Brazilian government promoted an international bidding procedure for an individual entrepreneur to come handle the commercialization of this energy and as a function of the commercialization he would be responsible for investing into the utility. I don't know much about the Garabi power

plant on the frontier. What I can talk about is about the existing Garabi, the converter station. The power plant also needed a study of course, which existed at the time already, I mean before we implemented Garabi the converter station. Indeed, the complete study encompassed the generation station on the frontier of Brazil and Argentina, at the basis of this plant, and the converter station. Because Brazil and Venezuela work their system with 60Hz but the other countries work it with 50Hz. Thus there was the necessity for all the connections here to be converted. But the understanding that I have, the one that I know of, is that both were planned as early as in the 1990's: the implementation of the hydroelectric power plant and of the converter station. But only one was implemented at that point in time – Argentina had overcapacity and Brazil needed capacity and thus the tender was promoted in a way for the investor to be responsible for the implementation of the utilities.

- *Who promoted this tender?*

Brazil. Brazil mainly promoted a good deal of it. There is a part of the installation in Argentina also, but it's only the transmission line that reaches its point of destination. The major part of the investment was made in Brazil. I mean the converter stations, which absorbed around 80% of the investment. What was necessary was conversion and since these were to be constructed on the Brazilian side it was Brazil who promoted this tender. Maybe because… I don't know how the financing was organized, if it was with BNDES… I don't know that. But the Brazilian government did the tender. They signed an agreement with Argentina that later on had to be redefined because Argentina could not fulfill it, fulfill its duty to deliver energy.

**Extract 16**. *Interview with high-ranked official at the Ministry of Energy in Argentina on June 8th 2011. The interview extract sheds light on the discrepancies between Argentina and Brazil's fresh starting on the project of Garabi.*

- *The project was set up for the first time many years ago: in the 1970s. What are the reasons that revived it several times, put it on hold again and now really pushed it forward again?*

Well, it's difficult to come to an agreement between two countries. It's very difficult. For various reasons. Political ones. The political conditions of each country. From the year 2000 until 2005 Brazil was not interested to pursue the project.

-*Why?*

For political problems. But, finally, political considerations changed in a period when Dilma Rousseff, with whom I had the luck to interact several times, came to be in charge, and finally,

well, some factors changed and this determined the point of view of the minister to change and so we started our journey to find an agreement and slowly we advanced in the project. The private energy production company entrusted with the project had not a great desire to pursue the project. There was an internal technical issue, not a political one, that was not favorable to the project in Brazil. The technical and managerial staff did not have any special interest in Garabi, which is why despite the political decision taken by the Ministry of Mines and Energy in Brazil there was internal resistance at this company to lay the foundations for this cooperation. But little by little we managed to advance.

**Extract 17**. *Interview with a high-ranked technical engineer and auditing official at the Argentine administrator company of the Argentine wholesale electricity market on May 31st 2011. The interview extract focuses on the spatial discrepancies between supply and demand in the Argentine energy market.*

Electric demand is here on the geographic map. This is where we are. Here in Buenos Aires. Demand is 40% of the total demand of the country. The rest is distributed among the various electric regions. You see? So, here we have the power plants [indicates other area]. The installed potency in this spot, the supply does not match the demand territorially speaking. Supply is here [in Patagonia]. This is 21% of the supply and in the Comahue region, also about 21%. The rest is distributed around the country.

- *What about electric restrictions in the system? Is there enough capacity at the moment to transport the energy produced in these regions to Buenos Aires?*

Yes, it is growing, but… Your question is: are there electric restrictions in the system? – Yes, there are. The electricity system needs to be expanded. Of course: it needs to be expanded all the time. But… Let's get back to the geographic map: look at this area here [Comahue]. This is the richest area of our country. Four [high voltage] lines come all the way from there to this area. To Buenos Aires. To supply Buenos Aires. If you had more lines coming from here, you would also have more dependency on this area. And in the face of any blackout event you would have problems in the area of Buenos Aires. Because the one who is generating the energy is the cheapest available producer. So it is convenient to have all the energy coming from there. But if there is a blackout event there, you will have a blackout in Buenos Aires. So, up to a certain threshold level this is acceptable but… up to which threshold level? Well, the answer is provided by electric modeling studies. There they evaluate what we are willing to accept with regard to a

blackout event. If there is a blackout event there is an immediate interruption of the energy injected to the system. Of how many MW? – Of around 1'000 MW. Each line carries around 1'000 MW, 1'100 MW, 1'200 MW. If a line is interrupted, roughly 1'000 MW are missing. That's a quarter of the overall demand of Buenos Aires! It's an important number, a huge disruption. Thus, what we watch out for is to have generation also in the area of consumption. In order to be able to cover and if necessary make up for potential breakdowns.

- *Thus it is important to not only diversify the matrix in terms of sources but also in terms of positioning of generation in the system?*

Exactly. It should not come all from one area.

**Commentary**. The presented extracts address *the shifts in the political prioritization of the Garabi project in Argentina and Brazil* from 1997 until 2003/2005. If we look at these extracts we can observe how the discovery of gas in Argentina converts it into a major exporter on the world energy market. On the Brazilian side, the reduced scope and low density of the Brazilian generation and transmission grid provoked the requirement to import on the Brazilian side. Hence, these two actor-networks and the technical impediments induced by different frequencies converged towards the construction of a converter station and towards the construction of a market relationship between Argentina and Brazil. The official speculates that Brazil was also pondering the construction of the hydroelectric power plant at the time but apparently the short-term considerations of the Argentine government led to the decision not to invest in joint generation at a point in time where cheap gas deposits were available. If we look at extract 16 we can observe how Argentina was forced to revise its priorities due to the fast drop of its gas reserves. Nevertheless this re-prioritization did not immediately coincide with the priorities of the Brazilian energy sector who had incurred an energy crisis precisely because of its over-investment in hydro. In the period between 2000 and 2005 the government of Brazil therefore had other investment priorities on its energy agenda. When the strain on the Brazilian authorities was finally eased towards the mid-2000 and the political decision-makers of the Lula government declared that it was a stepping stone for the fostering of economic growth in the region (c.f. extract 8 and 13) it was the economic cost-effectiveness that first slowed down the resolve of the entrusted private generation company to participate in the project (c.f. extract 9). Another element that adds to the reprioritization of the Garabi project in Argentina is the increased economic activity and population growth in the North-East of Argentina, especially the Greater

Buenos Aires area. If we look at extract 17 we can observe how the increased demand for energy in Buenos Aires and its provincial surroundings shifts the priorities of electric energy distribution across the country. What the official is talking about is that due to this alteration in settlement numbers and economic activity, demand and supply patterns in Argentina do not match each other at the moment territorially speaking. On the one hand this is because it is regarded as wise from an economic standpoint to maximize the production factors where they produce cheapest, and thus much of the energy used in Buenos Aires comes from the Comahue area or from Patagonia (which is mainly hydro, A.N.) On the other hand this is because there is not enough installed potency close to the centers of demand in the country. Because of this situation, the interviewed official forecasts two potential mid- to long-term shifts in the Argentine energy landscape: on the one hand, this is the construction of further transmission lines from the spots in the Comahue region where energy is currently produced (distance to Buenos Aires ca. 1'200 km). Since the installed capacity is not endless in these nodes either, the construction of further generation plants must however be considered. Shifts in this realm are generally approached on the basis of the cost-production relation of the plant itself, on the basis of the incurred friction loss via transmission, or on the basis of geographic and meteorological conditions along certain transmission corridors and production locations that would endanger the project. The official is arguing that due to the technical ease of installing a plant in Garabi (c.f. extract 10) and the proximity to the centers of demand discussed in the extract the project fits well into the current expansion plans of the government.

**For further investigation into the interlinkages between the prioritization of Garabi in the national energy agendas and other situations the reading of extracts 1, 6, 7, 8, 9, 10, and 13, 35 and 36 is recommended.**

**Interim conclusion**

In the subsection entitled "initiation" I have aimed to highlight elements and situations (c.f. Q8)[48] that look most significant for the constitution of the Garabi project from the perspective of the interviewed experts. In total, I have presented nine vignettes that I fabricated out of 16 interview extracts.[49] The topics of the vignettes covered the situations of *the 1990's gas crisis in Argentina, the concern over the availability of technical and civil engineering expertise in Latin America,*

[48] I include the reference to the questions formulated at the end of chapter five in brackets as 'signposts'.

[49] C.f. the introductory paragraph on vignettes: one can also argue that each extract constitutes a vignette in itself.

*corruption in the Argentine government administration, the practices of electricity pricing in Argentina, the motivations of political support to the project, the importance of existing technical installations and utilities, the mismanagements and reform efforts in the Brazilian energy sector, the bond of regional diplomatic relations and the shifting political prioritization of the Garabi project during the years of 1997 to 2006*. Further situations could easily be illustrated under the premise of further expert interviews. The presented selection can however be regarded as a first explorative breakdown of those convergences in elements and situations that seem particularly noteworthy with regard to the re-emergence of a new transnational Garabi project (vis-à-vis the project of the 1970s). Two things can be deducted on the basis of the profusion of cross-references among the presented vignettes in this section: the first deduction is related to the fact that the initiation phase is the phase that dates back the most years with regard to my fieldwork experience. With regard to possible explanations of which elements and situations interacted with each other in such a way as to bring about the emergence of the Garabi project (Q7) it therefore constitutes the phase on which the experts have had the most time to reflect upon and to fabricate their own interpretations. Their perspectives and answers to my questions must obviously be read as ex-post facto rationalizations, however, as particularly rich and nuanced ones.

The second deduction that is possible from looking at the multiple cross-references in the data is that there exist some situations that occupy a center-stage position in the overall "assemblage" of Garabi (Q9). This concerns particularly the 1990 gas crisis in Argentina (extract 1), the availability of technical and civil engineering expertise (extracts 2, 3 and 4), the bond of regional diplomatic relations between Argentina and Brazil (extracts 12, 13 and 14) and the shifting political prioritization of Garabi in relation to these situations (extracts 15, 16, 17). These three situations entertain the most cross-linkages with other situations. Though the number of cross-linkages cannot be taken as unfailing "evidence" of interlinkages (after all they are *subjective* fabrications of mine), the large number of interrelations indicate significant concentrations of structured relations in these situations and the probability of a very *critical* impulse to the pace and direction of the project of Garabi. In total 10 cross-references can be discerned for the situation of the gas crisis, 8 for the situation related to engineering expertise, 20 for the state of regional diplomatic relations and 9 for the political prioritization of the project. The shifts that appear as the most noteworthy in the re-configuration of agency in the context of Garabi are the foregrounding of gas as a basic energy source in Argentina (e.g. extract 1), and the experience of energetic and economic crises in both Argentina and Brazil (e.g. extract 15, 16 and 17). Both

shifts are highly dependent on the material availability of natural resources (gas, rainfall). These situations and the related shifts are thus a particularly ideal example to illustrate how a priori weakly 'structured' material objects may become subject to variable assessments by human actors depending on the situation in which they are embedded (Star and Griesemer 1989, 393). If we consider the gas boom in Argentina, for example, we can observe how gas modulated Argentina's reputation as an energy supplier under conditions of abundance and under conditions of depletion. Similarly, we can observe how rainfall modulated Brazil's reputation as a renewable energy producer under conditions of abundance and in absentia. With reference to the lack of energy and financing possibilities for new infrastructures the difference in material realities also led to different investment evaluations in the two countries. In Argentina, the sudden unavailability of gas as a cheap energy resource led to the re-consideration of hydro as another cheap resource that additionally possesses is relatively abundant in the country. However, the lack of homegrown expertise in hydro engineering and the limited financing capabilities of the state treasury countermanded such plans and led to the emergence of renewed interest in the cooperation with Brazil on the topic, as Brazil possesses both expertise and and the potential to share investment burdens. On the other hand, the large drought in Brazil led to a reconsideration of alternative energy sources apart from hydro which, at least at first, interfered with Argentina's wish to resume the cooperation on Garabi. Only the sustained resumption of economic growth in Brazil would later bring the potential for cooperation with Argentina (c.f. interlinkages with extracts 11, 12, 13).

**Planning and design**

In the previous subchapter I have mapped out a range of elements and situations that contributed to the re-emergence of the Garabi project on the political agenda of Argentina and Brazil. This subchapter explores how selected elements and situations were taken up in the subsequent phase of planning and design of the project. My empirical account of this phase of the project presents four vignettes that I fabricated out of 9 interview extracts and that illustrate how selected elements and situations are lent significance by means of the appointment of project teams and the production of project-related documentations. The vignettes cover the realities of 2005/2006.

**Extract 18.** *Interview with a high-ranked technical engineer in the Argentine energy trader on May 27th 2011. The interview extract focuses on the setup of the project team at the beginning of the planning phase. It discusses the relevance of material-technical aspects and the way in which specificities of Argentina and specificities of Brazil are synthesized in the project design.*

I am in charge of this project. Due to its binational format we need to coordinate before we do anything. We say: "Let's do this study". And then we start to work jointly. Each group elaborates its suggestions on the basis of its own methodology and we arrive at a common solution. To be honest there is not much difference on a technical level. Because the two of us are looking for quality. And we both know the technical state-of-the-art. Therefore it is fairly easy, at least from a technical point of view, to reach an agreement. The thing where we feel that it is a little more complex is from the point of view of energy markets. They have a different kind of market than the one we have but the utility needs to fit both markets, no?

- *What differences are there between the two markets?*

We will have to adapt the installed potency of the plant because the Brazilian energy market is predominantly hydroelectric. Our market is less than 30% hydroelectric, it is thermal. This implies that here are certain conditions for embedding the hydroelectric electricity into the Argentinean market and other conditions to embed it into the Brazilian market. The price for the installed potency is different in the two countries.

**Extract 19.** *Interview with a high-ranked technical engineer in the Argentine energy trader on May 27th 2011. The interview extract focuses on the steps carried out to form an organizational structure which is apt to deal with the management of the project.*

I am the technical manager and this is the department that manages the Garabi project. I started in 2005. My department is currently under development. It did not exist when I started here in 2005. I started as an employee, then they promoted me to Head of the Technical Department for the management of some special projects that were underwritten when the company started to work on Garabi. Our company did not have today's structure at that time. When we started we were mainly entrusted with commercializing energy. Only later did we start to form this project management structure. Today we have... and I insist, the structure is still growing in accordance with our necessities. Thus since the first stage of the inventory studies we have an environmental area. This is of great importance today, the environmental department. Currently, four people are working in this area. Then I have a department for technical engineering. This one is also still

under construction: we are currently 3 people working in this department. Because we are trying to adapt the structure to our necessities. What is certain is that the technical area of Argentina has lost a lot of professionals. Because during 20 years we did not construct anything in hydro and it has therefore become very difficult to hire specialized engineers on this topic.

**Commentary**. The presented extracts address the *set-up of an organizational structure* in the Argentine energy trader entrusted with the management of the Garabi project. If we look at extract 18 we can see how the planning of a joint infrastructure project prompts the necessity for transboundary coordination. In the initial steps of the planning and design phase this becomes visible in the setup of coordinative meetings between project teams. At this point in time where there exists hardly any knowledge at all about the upcoming project the teams elaborate individual suggestions on the basis of their state-of-the-art methodology and technological practices. Only afterwards are the individual suggestions compared and homogenized across different actor-networks. One such adjustment that is carried out for the sake of homogenization is thus to be found in the definition of the installed potency of the plant. What needs to be found is a solution that integrates itself equally well into the Argentine energy matrix with its economic requirements and characteristics and into the Brazilian energy matrix with its economic requirements and characteristics. If we continue and look at extract 19 we can learn more about this initial phase of the project set-up. The second extract from the same interviewee adds the explanation that the first department to be established in Argentina at all was the technical one. However, he clarifies that the technical department was not formed 'in vacuo': at the time, the company within which Garabi would be handled existed already and the manager interviewed in this extract was employed as the first manager to deal with the task of technical management of the project. Subsequently, the emergence of the Garabi project forced an organizational re-structuring as the tasks to be accomplished in this regard grew larger and more numerous. From a company perspective, the previously very circumscribed task of commercializing energy morphed into one that could also accommodate project *planning* and *management*. This re-organization within the company is still ongoing and will continue to morph along the various project phases as e.g. after the inventory studies who were supervised by the environmental manager (c.f. extract 20). The manager states that the posts and departments are created according to the team's emerging needs. In accordance, he states that the environmental department was specifically created in view of the preparatory steps for the inventory studies

which required additional expertise in the evaluation of published documents, technical reports and the like. On both an organizational and ideological level, the establishment of an environmental department also manifests the consolidation of environmental expertise within this company that was earlier only concerned with economic commercialization procedures.

**For further investigation into the topic of organizational set-up during the planning and design phase with other situations the reading of extracts 1, 2, 3, 4, 20, 22, 30, 31, 32 and 33 are recommended.**

**Extract 20**. *Interview with high-ranged environmental manager in the Argentine energy trader on May 27th 2011. The interview extract focuses on the steps carried out to form an organizational structure which is apt to deal with the management of the project.*

I started working here in 2006 and I started specifically in order to deal with environmental topics related to the joint project with Brazil. I am the one who leads the environmental department as a representative of Argentina. I am working here from the very beginning of the project.

- And what are the other departments here in this company?

Well...

- How many people work here?

Well, we are only few people. To be honest we are somehow the continuation of the former company that dealt with sewage and energy generation from water. But this company was dismantled in the 1990s and this is when our company was created. In the beginning the task of this company was merely dedicated to the commercialization of energy produced in transnational plants like Yaciretá and Salto Grande. The company dealt with the more administrative tasks of this commercialization. There was no technical team dedicated to new projects. Then from 2005 onwards, if I remember well, the company began to promote also more technical questions. This is when our technical manager started working here. I think that he was the first to start working on this technical area of our company. And after him it was the department of cartography and geographic information system that was created with one person working on these issues. And in this way, our organizational structure was shaped little by little. At the beginning we were two or three people and then slowly a team began to form. And as this process went along we later also started to consult the Secretariat of Energy in other questions beyond the development of water resources on the shared intersects of the river Uruguay. That is to say that we started to work also on environmental affairs related to national projects of the Secretariat. But our principal

responsibility remained the work on the river Uruguay. And for this task we are still a fairly small team. We would be seven or eight persons in total. Together with the manager of the commercialization department, the people from the legal area... we work a lot with the people from the legal area as well. Yes, and then there is the technical department. So in total we must be about seven to eight persons. And we will keep expanding this structure as we see further necessity for this, no?

**Extract 21.** *Questionnaire filled in by an environmental analyst at a large power generation company in Brazil and received on July 30th 2011. The answer of the analyst refers to her starting on the project and to her duties within the project.*

I am working on the Garabi project since 2005. My duties concern the assistance to the environmental inventory studies on the river Uruguay. Besides I am in charge of implementing management tools related to environmental governance in our affiliated companies.

**Commentary**. The presented extracts address *the insertion of the environmental department* into the Argentinean energy trading and the Brazilian energy production company. It specifically highlights its distinguished relevance for each of the company structures. From this extract we can see that as early as 2006 the topic of environmental project management gained importance and that the organizational structure within the Argentine energy trader entrusted with the handling of Garabi was accordingly expanded for this reason. Apart from this shift, a previous organizational change is mentioned by this interviewee that explains the very limited profile of the company previous to 2005. In the 1990s, before the liberalization move in the Argentine energy market, the organ that is now a company in its own right was merely a department of a bigger state-owned company dealing with sewage and energy generation from water. In the privatization move this company was absorbed by new institutional structures and a separate company was created out of this department, which then was entrusted with the circumscribed task of commercializing the energy produced in the transnational plants. In this extract, the interviewee also confirms that the integration of Garabi into the portfolio of the company must have happened around 2005 with the coordinated organizational adaptations in the technical realm. Before the creation of the environmental area, a department of cartography and geographic information systems was established for the processing of geographic data. By the date of my interviews, one can say that there still exists some contradiction as regards the institutional

affiliation of this environmental manager within the overall team of this trading company: on the one hand she perceives herself as leading a distinct department concerned with environmental relations, on the other hand she still sees herself as forming part of the technical staff. This can be interpreted as an iterative adaptation to changing material circumstances. The technical infrastructure acts as an organizing principle for social relations but these social relations need also to be supported by apposite performances. In other words, what I want to say is that despite the formal reorganization of the team, the internal distinction of the individual people does not seem to be very much internalized by this interviewee yet. Lastly, and as a slightly different re-organization in the company triggered by human-nonhuman interactions on the topic of the management of Garabi, I would like to mention the expansion of the technical responsibilities of the company towards the consulting of the national Energy Secretariat in national projects. This constitutes a fifth shift mediated by the emergence of Garabi on the business agenda of this company. If we look at extract 21 we can see how the support of the Garabi project in environmental concerns also started around 2005 in Brazil. By contrast to the Argentine office, however, this Brazilian office already dealt with national projects and the emergence of the Garabi project on its agenda constituted a reverse expansion of its duties and tasks, that is, one that came to incorporate also transnational projects besides only national ones.

**For further investigation into the interlinkages between the environmental department and other situations the reading of extracts 18, 19, 24, 25, 26, 27, 28 and 29 is recommended.**

**Extract 22**. *Questionnaire filled in a Brazilian manager of energy production at a large energy producing company. The interview extract focuses on the establishment of another working group. This time an executive one under the umbrella of the chancelleries.*

Since 2006 I am involved in the activities of the Treaty that was signed between Brazil and Argentina regarding the development of water resources on the shared intersects of the River Uruguay.

- *Please describe the activities that you have performed until today with respect to the planning of Garabi.*

I am a member of the Coordinating Commission that is designated by the treaty. On the Brazilian side it involves professionals from our company, the Ministry of Mines and Energy, the Ministry of Foreign Affairs. On the Argentinean side similar organs are involved. The Coordinating Commission holds an executive function with regard to the activities foreseen in the treaty.

Following the decision of the governments, the joint activities in this phase of the project are composed of revising the inventory of the River Uruguay on the shared intersect of the two countries, and, once the inventory is concluded, of commissioning the feasibility studies for the two water developments indicated in the inventory. Speaking chronologically, the inventory indicated two specific positions (Garabi and Panambi) and we are now in the process of getting these studies approved by the two governments. The feasibility studies for these two positions are still under tender. Hence, we are in a phase that is anterior to the [actual] planning of the project of Garabi.

**Extract 23**. *Interview with a high-ranked official at the Brazilian Ministry of Mines and Energy (MME) on June 30th 2011. The interview extract focuses on the cooperation between two distinct administrative political entities as Argentina and Brazil in a transnational hydroelectric project.*
Garabi is a hydroelectric project that is different from the rest of the Brazilian projects. Because the hydroelectric potential is not Brazilian, it's binational. So, it is handled differently. It is a kind of handling in which at every moment in time both the Brazilian and the Argentinean legislation must be taken into account. Concerning the environment, the regulation of the concession. So, on the Brazilian side, the concession is in the hands of Eletrobrás, and in Argentina you have their model. So, on behalf of the concession, the exploration of the hydrological potential, the environment, people will have to attend to both the Brazilian and the Argentinean regulation. In other words, of the two regulations, people will have to attend to the more demanding.

**Commentary**. The presented extracts address the situation of *assembling two political-administrative units* into one project team. They deal specifically with the question of how the set-up of the project does justice to some relevant pre-given collectives of Argentina and Brazil. If we look at extract 22, an interesting shift in social relations that we can attribute to the planning of Garabi concerns the mushrooming of coordinative commissions and executive organs. Despite the "top-down routines" professed in the interviews by high-ranked political officials (c.f extract 26) if becomes manifest from the statement of this manager that the 'practice' of "top-down" decision-making is intrinsically dependent on localized knowledge. Whithout this knowledge it is impossible to take decisions on a federal level. What this manager describes is that "top-level" decision-making is being deconstructed into interrelated and sometimes overlapping local knowledge communities before it is returned back to the authoritative decision-makers. With

regard to Garabi this resulted in the emergence of an executive decision-making committee with subordinated study groups for the different tasks to be handled. The executive committee mandates the study groups to prepare a report on issues of concern, supervises it and feeds it back into the federal level decision-making unit for legal 'passage'. The presented extracts represents the manager's perspective on the process of political decision-making. It will become clearer from the statements in extract 30 that it is difficult to conceive the reality of knowledge creation in such a sequential fashion as it is described here (in extract 22). From the perspective of professionals working closer to the local realities of the project, the work and knowledge deployed appears rather as situated and interrelated, thereby constituting an illustration of the profound intermeshment of several knowledge areas in the planning process of Garabi. Nonetheless, it seems to be constitutive also for officials working in the" top-level" of government to cling to political-administrative and thus sequential patterns of thought. If we look at extract 23, we are able to highlight similar shifts as in extract 18: On the one hand, the joint infrastructure project creates the necessity for transboundary cooperation and harmonization among humans and things. Despite the obvious reality, we are made to believe once again that first two individual benchmarks are adducted which are subsequently harmonized with each other. In this process the most demanding regulation is selected among the two regulations of Argentina and Brazil. In the present extract 23 we learn that environmental regulations and legal provisions regarding who may be entitled to obtain the concession differ between Argentina and Brazil. Additionally, we may observe that, in Brazil, the concession has been attributed to one of the large power generation companies whereas in Argentina the commercialization is not yet formally attributed. But during the interviews it looked probable that it will stay within the Argentine energy trader entrusted with the project management of Garabi (EBISA and Eletrobras 2010).

**For further investigation into the interlinkages between the assembling of the distinct political-administrative units into one project team and other situations the reading of extracts 24, 25, 26, 27, 28, 29 and 30 is recommended.**

**Extract 24**. *Interview with a high-ranked environmental manager in the Argentine energy trader on May 30th 2011. The interview extract focuses on the cooperation between the Argentine Federal level and the provinces.*

- *What about the involvement of the provinces in this international project? How do you proceed to involve them into the Project?*

In Argentina, the provinces also intervene. The province of Misiones and Corrientes; according to the circumstances. The provinces of Misiones and Corrientes intervene with regard to Garabi, and Misiones with regard to Panambi. In Brazil it is a little easier because when a binational project is concerned, the states give the authority directly to IBAMA. IBAMA is as if it were the Secretariat of the Environment in Argentina. So, in Argentina we have to work with the provinces, with the provincial authorities. And we have to conform and make accept – when the environmental evaluations are here – by the nation and the provinces

- *And do you interact with different ministries in the provinces? I am sure there are health topics, environment...*

Yes, yes. The provincial authority is always an environmental one. Let's say an authority entrusted with the application of environmental norms. Thus, in Argentina we don't have what we use to call a 'single counter' in this project. 'Single counter' means that well, when all the environmental studies are done we submit them to this counter and this counter replies to us on everything. No. We have to go to the 'counter' of the Energy Secretariat and to those of Misiones and Corrientes (for Garabi) and to Misiones (for Panambi). It's a complex situation.

- *Has this happened already?*

In this case of Garabi it has not happened yet. It has happened in other cases. In this case nothing has happened yet but the provinces are very active and they obviously want to sit down and work with us.

- *In matters of planning and design?*

Sure, sure. They want to be part of it, logically. So, let's say in Brazil, Rio Grande do Sul, according to the normative legislation delegates its authority to the nation, to the federal state. This is not the case in Argentina. Where, in addition, the natural resources, the rivers pertain to the provinces. Argentina is a federal state and this ads an additional layer to the management of the environment, no? With regard to how to comply with the proceedings…

- *And what are the next steps in this environmental plan? Have you already scheduled meetings with the provinces?*

Yes… later we will. Yes, Let's say the provinces were connected to us, too, since the beginning. Let's say the representative of the provinces were in contact with us.

- *Since when?*

Since 2006. Also before that. When I started here in 2006, there were regular meetings because at that time we were working on what would later become the 'terms of reference' of what we then used to call the 're-inventory'. Because the inventory studies had already been made a few years earlier. This is a very old project and this is why we called it a re-inventory. In these meetings we also had the representatives of the provinces of Misiones and Corrientes. We even worked with some of them on some issues of regional development. This means that the provinces have been present and still are present in our meetings and that they will be even more involved in what is to come. In this period, let's say from 2009/2010 we worked a lot more with the Secretariat for the Environment. The Secretariat for the Environment also has a direct connection to the provinces through the COFEMA, the Federal Council of the Environment, where all the provinces have formal representation.

**Extract 25**. *Interview with one of the senators of the Brazilian state of Rio Grande do Sul on June 29th 2011. The interview extracts highlights the relation between the Brazilian federal state and the subnational states as regards the planning of a transnational hydroelectric power plant.*

- How does the state of Río Grande do Sul participate in these international decisions between Argentina and Brazil?

Formally not at all. The state of Río Grande do Sul does not participate. There may not be any interference by the state of Rio Grande do Sul with regard to the international agreement with Argentina because it is a federal decision. However, the state of Rio Grande do Sul has participated [informally]. Before forming part of the Lula Government Dilma Rousseff was minister of Energy in that particular state and she advocated this whole question during two governments (Alceu Collares, PDT, and Olivio Dutra, PT) and it is from this background that she moved into the post of Minister of Mines and Energy for the Lula Government. That is why – i.e. because of her linkage with Rio Grande do Sul. I would say that Rio Grande do Sul has gained a lot from the Federal Government by means of the construction of the Garabi Power Plant.

**Extract 26**. *Interview with a high-ranked official at the Brazilian Ministry of Mines and Energy (MME) on June 30th 2011. The interview extract focuses on the involvement of selective collective entities in the enactment of Garabi. The interview took place in a group setting with also the environmental manager of the Ministry of Mines and Energy involved.*

The chancellery coordinates every treaty. So, first the chancelleries get involved. And then, on a lower hierarchical level of each country, in the case of Brazil, I will have all the organs that make the necessary decisions. This means that for hydrological resources we will have the ANA (Brazilian National Water Agency)… Then, from the point of view of the environment, you have IBAMA (Brazilian Institute of Environment and Renewable Natural Resources). On the dimension of electric energy you have the Ministry of Mines and Energy. And then I would also like to mention ANEEL (Brazilian Electricity Regulatory Agency) and EPE (Brazilian Energy Research Corporation). And in all aspects I will have to include the Ministry of Finance. So, there is no new organ that will handle a specific dimension because it is a binational project. The respective national organs will handle all the dimensions that have to be taken care of. Those organs that treat the same dimension also for national projects.

*Other environmental manager: Maybe her question concerns those study groups within the Brazilian electricity producing company.*

But his is a study group. It doesn't have the authority. It has been commissioned by somebody who is in control. So, who coordinates them today? Today you have a study group in Brazil where you have the technical coordination that is being made by one of our officials. One of our staff secretaries. In this study group... all those dimensions, you have representatives from all those areas to treat each individual topic. So you do not have an institutionalized organ that takes care of all the aspects. It is a study group that is coordinated by the chancellery, to direct the treaty. And then for the environment you have that organ that is entrusted with the environment at a federal level. And for water, that organ that handles water topics on the federal level. And in Argentina they have their own organs.

**Commentary**. The present extracts address the *issue of the internal fragmentation of states in transnational infrastructure projects* . In both extracts we can witness how the subnational organs of the two countries are involved in the project team (in addition to the frontier crossing in the transnational realm extracts 22 and 23). Looking at how the movements of association unfold between the entities involved in Argentina we can furthermore witness how the involved organs do not span the entirety of the subnational units. Instead, the spatial distribution of individuals and groupings endowed with authoritative competences is highly nuanced. On the contrary, Brazil is organized on a different model. In this country the involvement of the subnational states is *formally* not taken into account by the political decision-makers as the senator states in extract

25. No legal provisions exist that integrate the sociotechnical reality of the state of Rio Grande do Sul into the planning and design of the hydroelectric power plant of Garabi. That the sociotechnical realities also play a minor role for the *standing of the subnational states* vis-à-vis the federal ministries is exemplified in extract 26. The official states clearly that to him there exists a difference between what he sees as governmental authority and steering, and the *informal* consideration of the concerns of sub- and transnational entities. Indeed, says the official, the nature of the project requires due consideration of several interrelated actors but in his view the direction of the project is determined by the traditional political-administrative authorities. By contrast, the senator considers that it is impossible to totally separate these intermeshed environments. Decision-makers, such as Dilma Rousseff, carry parts of these environments with them into the decision-making processes at the federal level. According to the senator this happens through their socialization in these contoured sociotechnical environments and their internalization of the realities that are associated with them. Unconsciously, this affects the contents and quality of their decision-making.

Additionally, three other situations are visible from extract 24. The first thing is that the planning of the Garabi power plant not only operates a shift in the energy landscape of the country but also in its economic and labor relations. Via the mediation of the Garabi power plant the provinces start to think about possible development options and try to place their requests within the project management team of this Argentine energy trader. The preservation of existing conditions in the provinces is also included in the formulation of these requests. E.g. flora, fauna, livelihood issues for affected groupings. All of these are taken into account in apposite items that would later be part of the terms of reference of the re-inventory. Second, and as the interviewee states herself, the terminology of the *re*-inventory unveils the shift in the relevance of certain environmental items over others in the period of 1970 to 2005. We can regard these shifts to be mediated by the changing importance of certain materialities in the constitution of modern sustainable livelihoods. We will see further on (extract 28) that examples of such materialities can be found in ecosystems, rural labor conditions, and urban poverty induced by increased migration into the cities. Lastly, the mention of the comprehensive provincial association of provinces, the COFEMA, unveils how the ontological complexities of environmental affairs and their situatedness in individual provinces provoked the need for a standardization of contact persons via the establishment of this circumscribed association to deal with the coordination of the provinces on environmental concerns. In other words, the trigger and organizing principle of this

grouping is the material environment and the specificities of the human-nonhuman interplays that take place in the provinces.

**For further investigation into the interlinkages between the issue of the internal fragmentation of states and other situations the reading of extracts 4, 14, 20, 21, 22 and 23 is recommended.**

**Interim conclusion**

Once the decision to carry out the project was taken a number of operational steps had to be implemented. This subchapter on the planning and design of the project aimed at illustrating these steps by presenting four vignettes on the project-related cooperation and by analyzing their interlinkage with the elements and situations that led to the emergence of the project. The topics covered by the selected 9 extracts include *the set-up of an organizational structure, the insertion of an environmental department into the respective national companies entrusted with the project, the assemblage of two distinct political-administrative units into one team and the internal fragmentation of "states" with regard to the infrastructure project of Garabi*. They refer to the years of approximately 2005/2006. It becomes visible from the extracts that the set-up of an organizational structure goes along with significant uncertainty as to who or what must actually be included in the planning and design of the project (Q10). At this point in time there exists hardly any knowledge at all about the project and the teams elaborate individual suggestions on the basis of their state-of-the-art methodology and technical practices. The initial outline of the transnational project team (extracts 18 and 19) testifies that reflection on the involved elements and situations was very rudimentary: on the basis of three basic characteristics of civil engineering, transnational and environmental impacts of the hydro power project basic departments were established covering merely these dimensions (Q10, c.f. extracts 18, 19, 20 and 21). Significant foundation work by the project team was needed to follow up on the complexities of the project and to incorporate them into its design. As the teams advanced in their work, more significant elements and situations were unveiled, leading to the augmentation of structured relations in the assemblage of Garabi. The spreading out of the assemblage encompassed the strengthening of several areas such as the consideration of environmental implications within the project management team, the consolidation of cooperation practices with affected provinces in Argentina, and the interlinkage with competent national authorities in both countries. In all these cases, the inclusion into the project assemblage (Q11) appears to be dependent on the material

characteristics of the Garabi power plant and the question where relevant expertise on these characteristics could be gathered. The set-up of the project team, as well as the illustration of the ongoing interactions within it, reveal a highly nuanced spatial and temporal distribution of expertise and of relations among the involved human and nonhuman elements (c.f. Barry 2006). Hence, the relational characteristics of proximity become emphasized vis-à-vis the spatial ones. The extracts presented in this section also highlight, however, that traditional "top-down" thinking patterns are still common in some political-administrative groupings, as e.g. ministries or government-related businesses (c.f. extracts 22, 23). In the view of these selected interviewees the governance of infrastructural project is still considered as external to the sociotechnical realities on which it "is" imposed. In theoretical terms, theses interviewees operate a demarcation (Q10) between themselves and the localized interactions that surround the project.

## Execution

The previous chapter has explored how selected elements and situations were accounted for in the phase of planning and design of the project. Investigated questions dealt with the set-up of project teams and their dealing with relevant dimensions of the project. In this chapter I present six vignettes that I fabricated out of 13 extracts and that highlight how the planning of the project becomes more concrete. The vignettes are focused on the elaboration of terms of reference for inventory and viability studies and the appointment of contractors. They cover approximately the time period between 2008 and 2010.

**Extract 27.** *Interview with a high-ranked technical engineer in the Argentine energy trader company on May 27th 2011. The interview extract focuses on the steps carried out to put the viability studies of the Garabi hydro power plant out for tender in 2008.*

The inventory determines the possible watershed developments in the shared intersect of the river Uruguay. But what happened? These studies had already been carried out in 1976, 1977. At that point in time the environmental requirements for such a project were different.

- *What were they like then and what are they like now.*

Well, before they didn't exist. They depended directly from the vision of the engineer. Today every county has an environmental structure of its own. This structure foresees that certain environmental conditions need to be respected. Brazil has such a structure and Argentina has

such a structure now that didn't exist in 1976. So we had to do the study again and we arrived at the conclusion that we had to reduce the reservoir of the power plant and thus the potency of the plant. In general, the engineer's appreciation of the environmental power plant depends on the volume of the power plant reservoir. The conditions of the river vary according to the planned reservoir. The surface that possessed an economic profitability with regard to tourism or livestock acquires a profitability from an energetic point of view and well, generally, this is done in areas that are not densely populated so from an engineer's point of view the profitability of the surface is actually incremented. But well, the winds have changed nowadays and in Brazil for example the people are categorically against the construction of hydro power plants in the Amazonas. But this is another topic.

**Extract 28**. *Interview with a high-ranked environmental manager in the Argentine energy trader on May 30th 2011. The interview extract focuses on the contents of the inventory studies.*

- *How do you determine the most appropriate spot for the utility?*

The inventory study basically analyzes the topographic ground depression, I mean, just the binational intercept, not the whole topographic depression… it analyzes where the best spot for the plant is situated on the binational intercept of the River Uruguay. When I say the best alternative, I mean the best alternative from an economic point of view; both financial and environmental costs are considered. Of course, only on an inventory level. It is on the basis of the inventory studies that the identification of the best alternative for Garabi emerged – in its original position, at the altitude where we positioned it – and Panambi [a second plant that was introduced later; A.N.]. We also studied other positions for Garabi. So, we studied different alternatives and this one resulted as the best one. But anyway, even if one selects the best alternative, there are always significant impacts for the environment because we are talking about two 'big' power plants. So, there are always very significant environmental impacts. Power plants imply… for example, the flooding of vast areas, very vast areas and this implies the modification of physical, biotical aspects: fishery, biodiversity etc. etc. And then of course all the anthropological aspects that are key: the dislocation of populations, the disappearance of some city centers etc. There might also be an issue of flooding archeological areas… So, even if one selects the best possible alternative, there are always impacts that are highly significant because of the size of the works and because of the specificities of the power plants.

**Extract 29**: *Interview with an Argentine senior scientist on May 23rd, 2011. The interview extract explains how the levels of the reservoir envisaged for the power plant changed as a consequence of the inventory studies.*

I want to show something to you. For example: Garabi. (He points at a page of the inventory study of EBISA and Eletrobrás published in Portuguese in 2010):

**5 Estudo de Inventário de 1974**

No estudo de inventário realizado em 1974, pelas empresas AyE (Argentina) e Eletrobras (Brasil), foram definidos 3 barramentos com as seguintes características:

**Quadro 5.1-1 –Características dos Barramentos do Estudo de Inventário de 1974**

| APROVEITAMENTO | NÍVEL DO RESERVATÓRIO (m) | POTÊNCIA (MW) | ENERGIA (GWh/ano) | ÁREA DO RESERVATÓRIO (ha) |
|---|---|---|---|---|
| San Pedro (Inv. 1974) | 52,0 | 710 | 3.612 | 177.000 |
| Garabi (P. Básico 1986) | 94,0 | 1.800 | 6.083 | 81.000 |
| Roncador (Inv. 1974) | 164,0 | 2.200 | 8.985 | 115.800 |

The inventory studies from the decade of the 1970s until the definitions of 1984: So, Garabi would have 1'800 MW of installed potency. And the reservoir was to affect 81'000 hectares. Well, the new inventory, published last year, in 2010 determined an installed potency of 1'500 MW and 64'000 hectares of affected land. The total of the project should have had 4'700 MW of installed potency in 1984 and a total of three reservoirs. Three because originally they sought to construct three plants [historically Garabi, San Pedro and Roncador; EBISA síntesis final 2010].

- *To what extent were these projects developed?*

Not at all. They are merely projects. Defined in 1984. Not constructed. We are talking about 4'700 MW of potency back then and of 373'800 hectares, let's say 374'000 hectares to round up, of flooded land. Well. With the revision of the inventory studies it was agreed on minimizing the environmental impact. Consequently only two of the originally three hydroelectric plants will be constructed.

- *But San Pedro and Roncador were totally different projects than Panambi, no?*

We'll have Garabí on the one hand and on the other hand San Pedro and Roncador converge in the project of Panambi. Instead of 4'700 MW it will be only 2'200 MW. Instead of 374'000 hectares of flooded land we will have 97'000 hectares. This is a planning to minimize

environmental impacts. This is what the Chileans forgot to tell their people earlier this year. On the level of social communication I mean (interviewer refers to the beginning of our conversation, A.N.). Here we told our people about the minimizing of environmental impacts. In Chile they plan but do not communicate. Thus the public declares “no, no”.

**Commentary**. The presented extracts address *the modulation of technical, environmental and economic points of view* during the preparatory steps to the inventory studies and their later publication (EBISA and Eletrobras 2010). If we look at the first of the three extracts we can observe how an adaptation to the earlier project planning of the 1970s became necessary because of the change in environmental regulations. During the 1970s the idea of *sustainable* livelihoods was still undeveloped and technical feasibility and innovation were considered as the main criteria for construction engineering. By contrast, at the present time, geographers, biologists or interrelated environmental sciences can be considered as having gained relevance vis-à-vis the technical engineers and the economists. For the project of the Garabi power plant this means that the earlier relations between the infrastructure and its environment needed to be revised and mapped out afresh. Specifically, an ideological dimension with regard to the interpretation of engineering figures had to be taken into account: that is the normative refusal to accord equal normative relevance to economic profitability and technical feasibility on the one hand and sustainable living on the other hand. Hence, the second extract (28) illustrates how figures that are conventionally taken to represent ‘neutral’ topographic and environmental information become “boundary objects” in the sense of Star and Griesemer (1989, 393). In the context of environmental decision-making they aquire the potential to re-organize existing relations between the material infrastructure of the power plant, fishes, other animals and plant species that can be found in the area, and also between the material infrastructure and anthropological aspects like rural and urban livelihood, labor and the historicity of sites. Extract 29 then illustrates how the assessment of the kinds of infrastructural developments that were considered as environmentally viable changed greatly over the years.

**For further investigation into the question of how technical, environmental and economic points of view were modulated in the different phases of the Garabi project and other situations the reading of extracts 12, 14, 20, 21, 22, 23, and 39 is recommended.**

**Extract 30.** *Interview with a high-ranked environmental manager in the Argentine energy trader on May 30th 2011. The interview extract explores how the transnational project team works together in practice.*

Let's put it this way: the consortium of companies produces a product, the viability studies and the plan for environmental resource management. These products need to be evaluated by our company and the Brazilian energy generation company. Obviously the consortium needs to ask us for advice and authorization in many things. For example with regard to the environmental viability studies it is not sufficient for us to say "we approve this study". And afterwards the viability studies and the plan for environmental resource management also need to be approved by each of the competent organs of the nation-state. For this step the approval of the environmental organs of every country are very important. In Brazil it's IBAMA who needs to approve the study. Because under the federal laws the state of Rio Grande do Sul delegates its authority over the river Uruguay to IBAMA. And in Argentina it's the Secretariat for the Environment and Sustainable Development who approves the studies together with the competent authority of Misiones for the utility situated in Garabi and the competent authority of Corrientes for the utility situated in Panambi. We need all these approvals. Until they are not ready the project cannot start. Construction cannot be initiated without all those environmental approvals. It is logical that for such a whole lot of work we need to contract out the studies that are to be made. These studies are very very large, with many professionals involved, much fieldwork on-site in the region to be done. Fieldwork that is not only related to the environment alone but also to social issues, anthropological questions, sample taking and, last but not least, a lot of tasks with regard to the social communication plan. So we contract all of this out. But we elaborate specific directives for these studies. We consider the terms of reference for these studies to be our "Bible". But along these terms of reference there are continuous support and authorization processes going on our side and on the side of the Brazilian energy producing company. And then at the end the studies need to be approved by the national environmental organs. And the subnational organs in the case of Argentina. It's quite complex. And the environmental part seems to me to be more complicated than the engineering part. Why? Because the engineering part is not subject to the approval of the environmental organs of each country.

**Extract 31.** *Questionnaire filled in by an environmental analyst at a large power generation company in Brazil and received on July 31st 2011. The answer of the analyst refers to the composition and the dynamics of the professional team regarding the inventory.*

During the process of carrying out the inventory studies on the river Uruguay, on the shared intersect between Argentina and Brazil we carried out regular meetings with the Argentine energy trader involved and with the technical team that was contracted to actually carry out the studies. Internally also the departments of engineering and hydrological resources of our company were involved.

**Extract 32.** *Interview with a high ranked environmental manager in the Argentine energy trader, on May 30th 2011. The interview extract pictures the environmental manager's view on the viability studies.*

Our work is to put out calls for tender. This means that we do not carry out the studies ourselves. We supervise and correct the studies that others make for us.

- *Do you call out for tender for all the aspects of the project together or do you place a call for each individual aspect of the project?*

We put it out together. The contractor is a consortium of companies, that is a transitory union of companies. A TUC (Spanish: UTE). This is how we formulated the call. For a consortium of companies. And then they form their own teams for each of the environmental aspects we ask them to study and for all the rest as well. For each of the aspects they have a team, which we of course asked to be binational because on each side there are very specific sorts of knowledge. Even if the topic to be studied in each area of the study can be considered as comparable the realities in Brazil and Argentina are still fairly different. In the individual areas of the study I would say that the teams are fairly big in the environmental area. Big and differentiated. And some of them are really difficult to work on. Because there are professionals that are rare and hard to hire because they possess a specialized knowledge that not many professionals possess. For example with regard to the fish population in the area.

**Extract 33.** *Interview with a high-ranked technical engineer in Argentine energy trader company on May 27th of 2011. The interview extract focuses on the specificities of the call for tenders for the viability studies in a transnational setting.*

Well, this works just like any call for tender invited for by the state. The greatest difference from other call for tenders is that it is binational and this is why we decided – together with our Brazilian counterpart – to invite to an international tender. Apart from that the procedure is identical: we prepared the documentation, placed the call within reach of any international consultant... The necessity was to open the call internationally to get a better price. The inconvenience was that the international prices were higher in the international market at that point in time and therefore for us Argentineans this generated additional costs. Hence, for Brazil the call for tender was cheaper than it was for us. But well, these are problems of the binational settings. We accepted that and we set up the terms of reference for the studies together. The evaluation group for the adjudication as well as for the follow-up of the works included four Brazilian professionals and four Argentinean professionals. The adjudication was to be made jointly. With a whole apparatus of specifications. The bidding documents can be found on our webpage, where we also specified precedents, professional requirements and the desired methodology. In the case of the inventory studies a consortium of three companies gained the bidding. 50% of the study was attributed to a Brazilian consultant and then 25% each to two Argentine consultants. This consortium had only a small advantage over other consortiums. The criteria for adjudication were 70% methodology and 30% price.

**Commentary**. The presented extracts focus on *the call for tenders for the inventory studies* of the Garabi project from different perspectives. If we look at the first extract we can gain an appreciation of how actors intertwine in the process of governing the transnational hydroelectric power plant of Garabi. The interviewee tells us how the activities of the transnational consortium appointed to do the works is closely supervised and supported by the two national organs entrusted with the management of the project. During the studies a continuous exchange of information takes place between the different people involved and overlaps between different parts of the studies are the norm since interrelated aspects are being worked on simultaneously by different people. Once the studies are completed the results are however fed back to the existing national organs for approval who have not participated in the completion of the studies. Despite their non-participation in the concrete project they are thus involved in the project on the basis of their reputation and previous expertise in the topic of hydro utility construction and environmental approval. On the basis of the description sketched out in this extract we can observe how cooperation between ad-hoc teams and pre-existing collectives unfolds across

different temporal and geographic locations. The map of actors involved in the project of Garabi acquires a very distinct and highly complex form. The intermeshment of relations and the concomitant unfolding of different but potentially overlapping actor-networks also becomes manifest in extracts 31 and 32. The extracts illustrate well that every individual is dependent on a wide net of other humans and things in order to reach his goals. The extracts unveil how a grouping can always only acquire meaning in relation to a specific matter: for the inventory studies three distinct companies were interlinked in a transitory consortium of companies highlighting that agency in transnational utility planning is actually distributed *across* different sociotechnical realities and hence *across* existing business groups. Established relations within the individual companies need to be reassembled to fit the problem at hand. Finally, the last extract shows, how the opening up of the geographic scope for transnational contractors beyond the countries of Argentina and Brazil was in the end not lent significance by the transnational project team: in the evaluation of the offers by the transnational project team a consortium consisting of one Brazilian consulting firm and two Argentine consulting teams emerged as winning. In short, out of a large share of international applicants, the call for tenders for the Garabi power plant resulted in the prioritization of a team that is close to the regional realities of the project. One could conjecture on the basis of extract 29, that the selection of two Argentine companies is interlinked with the shift in price levels that is related to the "international" advertisement of the bidding. As the technical engineer states this "international" advertisement led to an increase in price levels (because the international prices at the moment were higher than the ones in Argentina) whereas for the Brazilians this meant a reduction in price levels. With the selection of two Argentine consultants and one Brazilian consultant the evaluators might have given consideration to this disequilibrium.

**For further investigation into the interlinkages between the call for tender for the viability studies and other situations the reading of extracts 6, 7, 13, 18, and 19.**

**Extract 34**. *Interview with a high-ranked environmental manager at the Argentine energy trader on May 30th 2012. The interview extract draws on the notion of uncertainty that remains even after the inventory studies have been carried out.*

Well, let's say, that work between the nation-state and the provinces is one of the complexities. But another issue is that environmental issues have a lot of – a LOT of - aspects. Many. And all of them may be conflictive. Some more than others. And this adds another aspect of complexity.

Still another such level is the level of uncertainty that is related to the impacts [of measures]. The environment you are going to impact on is unique. Both from the physical, the biotical as also from the anthropological point of view. So, you may infer some impacts from its properties and try to manage them… but you never really know how the impacts are going to unfold. So this is another aspect of this great complexity. And another aspect is also the issue of participation, and the issue of diffusion, of social communication, I mean. How shall we organize the social communication, how shall we organize the social diffusion? And how shall the different actors participate? Which are the more and less powerful actors? How does everyone participate? How do the media work with environmental issues? The media can promote or hinder. It's very complex.

- *How do you tackle these complexities in your work?*

Practice is difficult. Because in practical experiences, also within the companies or within the different governments, there are different opinions, there are different actors with different interests. Because even if one says 'the government' or the 'government sector'… it's not like we are talking about a world 'in a block'. It includes many different realities. Again, with its different actors, their different needs, different opinions, different temporalities…. One of the key aspects are temporalities? When to communicate? When shall we organize the communication? Is this when we (effectively) 'can' communicate? And another question is the fear of how it shall work out? The fear of one or the other actor. So, sometimes, fear delays some actions or accelerates others and then the result… I mean, it's a topic that is really difficult and logically it is about doing the best you can but it's complex. It's complex because there are previous histories. Previous conflicts that are stirred up: territories, environments are not blank sheets. Everything is like a palimpsest, there are histories written and rewritten and these histories affect what is to follow. Previous histories. Previous conflicts that are stirred up, remembered when a new project comes up. Also, there is a whole international movement against power plants. There are histories of Brazil and of Argentina that intertwine in all of this. This is what makes it fascinating, no? All difficult stuff is fascinating.

**Commentary**. The presented extract addresses the question of *how uncertainties are dealt with in everyday work*. If we look at this extract we can observe how material matter becomes a matter of concern when it becomes the center of contestation between multiple realities. The extract illustrates particularly well how every actor is supported by a series of actor-networks each with

its own characteristics and dynamics. During the viability studies several actor-networks that are constitutive for the Garabi power plant project are unveiled and solutions to deal with them are formulated in the plan for environmental resource management[50]. Nonetheless, it is difficult for the project team to assess how additional points of friction might unfold in each of the sociotechnical aspects of the project because the direction of change depends on the application of the measures in a precise spatial and temporal situation which, in turn, is related to a plethora of other elements and situations whose development is equally difficult to assess. Hence, according to the potential spatiotemporal interactions in the different assemblages novel elements might become foregrounded that were not an issue during the preparatory studies.

Almost prototypically for my study, the manager also emphasizes how individual people from the governance landscape, with the knowledge they have acquired on the basis of being embedded in very specific actor-networks, play a huge role in the project-related decision-making. The manager states very clearly that due to the many hidden relations that are 'folded' (Deleuze 2006) into an individual due to present and past experiences the notion of unitary decision-making in governments is misleading. Her statement corroborates the assumption that assemblages "accelerate and intensify agency in particular directions, and with unpredictable and dynamic effects" (Barry 2006, 241). The notion of flux and uncertainty becomes thus an intrinsic characteristic of infrastructural project management and regulation both in the run-up to the construction and in its aftermath. As Barry states citing Ong and Collier, "technological zones both interact with and contain other elements and forms occupying 'a common field in contingent, uneasy, unstable interrelationships" (Barry 2006, 250, citing Ong and Collier 2005, 12).This uncertainty is problematic because it demands the harmonization of different necessities and opinions of actors on aspects that are so diverse as biodiversity, fishery, human displacement, infrastructural interconnection etc. Additionally it demands the acquiescence of involved actors that even though the effects of their agency might be unforeseeable it must still be responsible.

**The present abstract is interlinked with all the other extracts in this chapter.**

**Extract 35**. *Questionnaire filled in by a Brazilian manager at a large private producer association in Brazil and received on August 30th 2011. The argument of the interviewee focuses*

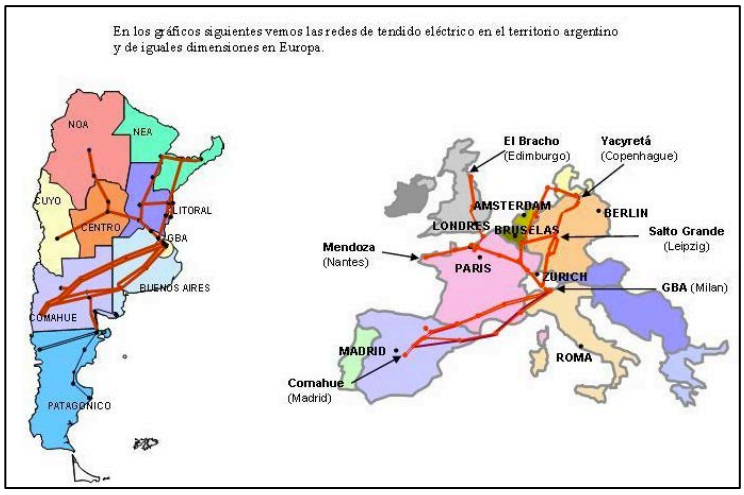
[50] Obviously several actor-networks also participate in the viability studies and the formulation of the plan for environmental resource management as we have seen before.

*on the current relevance of hydroelectric producers in Brazil and the challenges they face because the production centers of hydro are situated far off the consumption centers.*

Currently, we have 47 members who represent about 47 thousand MW, which is about 43% of the total installed potency of Brazil. From these 47 members approximately 90% are hydroelectric producers, the rest are eolic, biomass, petroleum, coal and gas producers. Since the hydroelectric potentials of Brazil are far from the consumption centers we are in need of transmission lines of great length. This in turn makes operation of the lines more difficult and requires more attention from part of the independent operator (ONS).

**Extract 36.** *Interview with a high-ranked technical engineer and auditing official in the Argentine administrator company of the wholesale electricity market on June 3rd 2011. The interview focuses on the geographic distance between the hydraulic plants and the important Greater Buenos Aires area. It speaks for the material necessity of an additional hydro plant that is close to consumption centers.*

First of all you need to acknowledge the dimensions of our country. We have 3'700 km in length and 1'400 km in width. Check out what fits into the silhouette of our country if we compare it with central Europe (image: courtesy of CAMMESA):




It is very different from Europe. The lines are incredibly long and thus they are not comparable with European electric systems. This has to do with topography: We have the mountainous area over here in the Comahue region and the plains are over here in the Misiones and Corrientes region. Thus, there are very very big hydraulic plants in this region of the North-East and

particularly the Comahue and this makes the system act like a huge spider web. If you touch it in one point, the whole web fluctuates, if you touch it in another point it fluctuates differently. That's how the electrical system works. This is why the characteristics of our grid are totally different from those of Europe… they are incredibly radial and incredibly long. Look again. If we examine the scale dimensions: Look at these dimensions! – Of course, Europe has a demand of around 400'000 MW while we have a demand of around 20'000 MW/y here in Argentina. Thus, the demand is very small with a very, very extensive grid! The characteristics are totally different! Actually, it is only now that we are closing the open threads of the grid, I mean we are linking the open ends of the grid: this coastline with the center. Thereby the system gets additional stability in this area. It is something very specific within our Argentine grid.

**Commentary**. The presented extracts address the topic of interrelated expansions that become necessary once the decision to construct the new hydroelectric power plant in Garabi is taken. In the first short abstract we can observe how the construction of hydroelectric facilities always provokes the necessity of grid adaptations. Because water resources are particularly contingent upon location, even in a country like Brazil, who produces 80-90 % of its energy hydraulically (Landau 2007), shall feel the need to construct additional transmission lines. Both the Brazilian manager and the Argentine auditing official of extract 36 emphasize that the operation of transmission lines of large extension requires special attention by the administrators because of the multiplicity of subsystems that interact with them over long distances. Extract 36 sheds some light on what the challenges of interacting subsystems comprehend. By highlighting some of the general characteristics of the Argentine electricity system the Argentine engineer and auditing official deducts elements and situations that are of relevance for the operation of the grid. First and foremost he is concerned with the scope and the radial character of the Argentinean grid. Reverting to basic notions of electrical engineering he explains that both characteristics represent a challenge for the distribution of energy around the country: the first because of the friction loss, the second because of the deficient stability and thus precarious reliability of the supply system in the case of being cut-off from the networked system. With regard to the second one, which is the main focus of my interviewee, the metaphor of the "spider web" is a powerful one in that it tellingly visualizes the necessity to have a grid that is evenly 'woven' so that it can balance eventual increases or drops in tension and not produce a disruption. What does this mean for Garabi? – In the enactment of this interviewee, the positioning of a new energy generation

facility in that corner of the Argentine country helps to diminish the dependency from other production regions. In addition, it is considerably closer to Buenos Aires than the facilities in the Comahue or the Patagonic area, resulting in less friction loss over long distance distribution. Considering that there already exist several lines towards Buenos Aires (and Brazil) from there, the construction of Garabi may thus be considered as a perfect match for the existing electricity grid.

**For further investigation into the interlinkages between the construction of the Garabi power plant and other situations the reading of extracts 10, 12, 13, 14, 25, 17, 34, 37 and 38 is recommended.**

**Extract 37**. *Interview with a high-ranked technical engineer and auditing official in the Argentine administrator company of the wholesale electricity market on June 3rd 2011. The interview extract focuses on the industrial specificities of the country and the way in which they need to be taken into account for an effective operation of the electricity grid.*

For example the level of economic activity. There are interactions that we can analyze. If there will be a strike, riots, some other kind of forced activity in a specific grouping. There are groupings that are highly important for the overall level of activity in the grid. For example, the iron and steel industry, the metal-processing industries. They are very electro-intensive and swallow a lot of energy. Therefore if we can foresee that there will be any action or forced activity in one of these groups like Labor Day for example, we know that demand will drop tremendously. Therefore the system operator has to account for that.

**Extract 38.** *Interview with a former Argentine manager of high voltage transmission that later became an independent consultant for energy planning and investment on May 31st 2011. The interview highlights the changes that became necessary in the Argentine transmission grid as a consequence of the rising demand in energy. It also considers economic factors of the country, e.g. the location of the important metal-working industries.*

What I did was to design a plan that is currently under construction and that will be terminated later this year. This is the closing of all the lines in 500KV along all the borders of Argentina. North, South, East and West. But why along all the borders? Because in this way we are connecting those provinces to the grid that possess the capacity to bring out large industries, for example the metal-processing industries, and that however did not dispose of sufficient incoming

lines to receive energy in 500KV. If I talk about 500KV I talk about the fact that we need to connect these provinces via a substation first and that from there on additional distribution lines need to be constructed for the individual consumers in this province. The distribution lines are 220KV or 132 KV, they are being constructed by the provinces themselves. But the lack of incoming 500KV lines significantly retarded the development of mining in San Jaun. The Pachón group and the Varig group, I don't know if you have heard of them, have considerably incremented mining production. But due to the high demand in energy of these electro-intensive industries – you know that mining uses a process called electrolysis to separate materials – they could not do their job properly without the necessary energy coming in at 500KV. Thus the government finally decided to expand the high voltage grid. The plan to do this is as old as 1986. 1986! But it is now that they put it on the agenda, initiated it, and are in the process of completion.

**Commentary**. The presented extracts address the *industrial specificities of the country* of Argentina. Specifically the location and type of two highly relevant industries the iron and steel and the metal-processing industries are addressed. If we look at this extract we can see how the demand of specific industries influences the work of the transmission system operator. What the engineer explains in this extract is that according to the use that each specific industry makes daily, differential measures have to be taken by the system operator to ensure the reliability of the grid. According to the working schedule of these industries different generation plants and production patterns are included in the planning. From the second extract we learn that the interconnection of some of the most important Argentine industries to the national grid has however only taken place very recently. Before the adoption of expansion plans, the lack of 500KV lines in certain regions constituted a matter of concern in certain geographically-bound electro-intensive industries such as mining. Of course, not every network expansion is viable, this is why many villages in the Argentine countryside are still not connected to the grid but rely on autonomous generation via small scale electricity circuits or household generation. However, due to their economic importance we can see how some industries that are of pivotal importance for Argentina's economic development are considered and foregrounded in the government's network expansion plans. Concomitantly, the extracts testify how the fostering of certain core industries goes along with a qualitative shift in the electricity grid itself. The construction of

additional technical links in formerly unconnected corners contributes to a better stability of the grid because of the multiplied possibilities for electricity redirecting.

**For furhter investigation into the interlinkages of industrial specificities with other situations the reading of extracts 16, 17, 35 and 36 is recommended.**

**Extract 39**. *Interview with a high ranked environmental manager in the Argentine energy trader on May 30th 2011. The interview extract deals with the role of non-governmental actors such as affected populations, other entrepreneurial entities, and the media and the way in which their agency develops the enactment of the project.*

So, if one analyzes the dimensions that are highlighted in the media there or in the different meetings, we see that health issues have been highlighted a lot. Dislocation has been highlighted a lot. The loss of biodiversity. The issue with the fishes… These are all impacts that we will have to deal with. Sometimes with more or with less information. I mean, sometimes they highlight things that have not been detected in the studies we made, or that are not at all possible for the present project…. But the preoccupations are real; they are related to the general issue. Sometimes you have to emphasize one, sometimes the other, but they are all impacts that are related to the construction of large power plants. And these are 'irreversible' impacts. You can compensate for them but you can neither avoid nor mitigate them. Once you flood an area it's flooded.

**Commentary**. In this extract the topic *of non-governmental organizations* is addressed. Specifically, the interviewee highlights how they play an important role in shaping the project despite their only indirect involvement with it. However, she also concedes that despite of the inclusion of the broadest public opinion possible and the selection of so-called 'best alternatives' there is no way to completely eliminate the environmental (e.g. issues of biodiversity, fishery, cattle stocks) or anthropological impacts (dislocation of populations, health issues, archeological issues etc.).

**For further investigation into the interlinkages between non-governmental involvement in the project and other situations the reading of extracts 27, 28 and 29 is recommended.**

**Interim conclusion**

This subsection explored how selected elements and situations were accounted for in the phase of *execution* of the project. In total, I have presented 6 vignettes that I have fabricated out of 13 extracts. The topics of the vignettes cover *the modulation of technical, environmental and economic points of view in the run-up to the viability studies, the different perspectives on the call for tender for the inventory and viability studies, the handling of uncertainty in large infrastructure projects, the emergence of interrelated adaptations, the foregrounding of industrial specificities and the involvement of nongovernmental actors such as NGO's and the media in the project*. In this phase of 'execution' it becomes particularly visible how localized knowledge is needed with regard to the further planning of the Garabi project. The presented extracts prove particularly rich in information on the pondering and modulation of the elements and situations relevant for the project. The first vignette illustrates well how technical and economic considerations are weighed against environmental aspects which at this point become foregrounded with regard to the project (extracts 27, 28, and 29). The extracts in this subchapter also show how the distinction between traditional actors as "the state", "private actors" and "engineers" are inadequate when it comes to describing the activities that are undertaken to assure the viability of the project. This becomes especially flagrant with regard to the illustrations of the bidding procedure for the construction works (extracts 30, 32, 31, 33). Especially in extract 30 we may observe how the activities of the involved groupings are reflexively intertwined with each other: activities of smaller working groups are closely supervised and supported by larger working groups and the exchange of information, which is continuous, goes simulatenously in horizontal and vertical directions (Q13). The extract also highlights the object-orientedness of social groupings: three different contractors were appointed for the inventory studies (Q12) that were intrinsically forced to coordinate and cooperate to meet the terms of reference established for the project. Most importantly, I find that these extracts highlight that uncertainty needs to the *acquiesced to and accounted for* by involved human actors *at all times*. It is not an indication of failure but a characteristic of such processes. Due to the multiplicity of relations that come together in such a large project and their reflexive embeddedness in other relations and situations it is indeed difficult to predict the directions that agency will take. Knowledge on the distinct dynamics and characteristics is iterative and never completed (Q13). If we consider, for example the vignettes dedicated to the question of interrelated grid expansion and industrial specificities of the electricity system we are obliged to acknowledge that these issues were probably foreseeable

but that until *after* the viability studies no *precise* knowledge on the topic existed (Q14). Similarly, the opinion of the media and non-governmental organizations could only be taken into account *after* the publication of the inventory studies to which they were a response.

So far, the gathered data provide no clear-cut answer to questions 15 and 16, that is with regard to the adaptations made to the terms of reference for subsequent steps or the specific enactment of the project on-site. One can only assume that questions like human displacement, environmental impacts, technical characteristics of the existing grid, or the state of diplomatic relations between the countries have the potential of unfolding further impact on the project. However, further investigation of the time after 2011 would be needed to assert this.

## Construction

The previous subsection has explored how the execution of the project became more concrete in the time span between 2008 and 2010. The presented vignettes focused on the elaboration of terms of reference for inventory and viability studies and the appointment of contractors. As a follow-up, this chapter is designed to explore how the elements and situations that were unveiled as relevant during the inventory studies were integrated in the planning of the construction phase (feasibility studies). The question is also one of 'position reckoning' as regards the state of knowledge that has been created so far with regard to the project. The subchapter only includes one vignette/extract because the run-up to construction was merely incipient at the time when I carried out my fieldwork. The vignette refers to the reality of 2010 (publication of the inventory) and 2011 (assemblage of construction).

**Extract 40**. *Interview with a high-ranked environmental manager in the Argentine energy trader on May 30th 2011. The interview extract deals with the question of how the assemblage consisting of human and nonhuman relations is taken into account in the further elaboration of the project.*

In this inventory study that we made recently we drafted a map of involved actors. This is because there have been different actions of actors in favor but most often against the construction of hydroelectric power plants. In the inventory study that was terminated in 2010 we evaluated the principal conflicts and the principal actors. Different levels were involved from

national to regional or only provincial level. This is with regard to the general actors. Besides, also universities are involved for example.

Additionally, we have worked with the Secretariat for the Environment and Sustainable Development, which is our competent national authority to formulate the terms of reference. We have consulted them with regard to the forming of a binational group for environmental studies and they have been very supportive in the drafting of the items to be included in the terms of reference for this second phase of the project, the feasibility studies and the call for tender regarding the basic project (proyecto básico). Actually, they have been our main interlocutor for the drafting of the terms of reference for this phase.

**Commentary**. *The present extract focuses on the build-up of expertise that is ongoing with regard to the construction of the Garabi power plant*. The extract illustrates that the newly formed study groups and organizational departments in the two entrusted companies created additional knowledge on the project of the Garabi power plant as e.g. a map of involved and impacted actors. In these maps, actors that were invisible before the project team got involved in activities regarding the planning of the project are now 'mapped' and integrated in the construction plans. The interviewee however also states that a lot of existing and Garabi-unrelated expertise from the Secretariat for the Environment and Sustainable Development was integrated into the drafting of the terms of reference for the feasibility studies and the bidding of the "basic project". In other words, we can see that newly created knowledge is always modulated with existing knowledge, and that knowledge production just like utility construction takes place in the interplay between heterogeneous human and nonhuman actors. For this extract there exist interlinkages with all the other presented extracts.

**Interim conclusion**

As regards questions 18 to 20 that I formulated in chapter five only the first one (Q18) can be explored by means of the data gathered until summer of 2011. We can learn from extract 40 that during my fieldwork the dense net of relations surrounding the project of Garabi was considered as substantially consolidated vis-à-vis the phase of initiation. This is made visible by the expansion of organizational departments, routinized cross-company practices and intensified federal-provincial exchange of information. From the perspective of the interviewed environmental manager the most important knowledge gain of the past years consists in the

mapping of involved actors and conflicts. It is, amongst other things, on the basis of this mapping that the further elaboration of the terms of reference for construction would take place. For this task of actor mapping, the environmental manager also resorted to her relations with competent national authorities in order to exchange experiences and forecasts as regards the dealing with the detected conflicts in the phase of construction.

**Conclusion**

The present chapter has highlighted a series of particular situations that proved consequential with regard to the emergence of the planning and construction of the hydroelectric power plant of Garabi. By means of my presentation of the perspectives of several actors involved in the process I was able to pinpoint that the emergence of the hydroelectric power plant of Garabi on the political agenda of Argentina and Brazil cannot be attributed to the will on any one of the involved political decision-makers alone. Rather did it hinge on the *convergence* of particular elements and situations that *in their ensemble* participated in the *assembling of agency* in this particular infrastructure project. By means of indicating the interlinkages between the vignettes I have aimed to provide a social model of how the multiple and overlapping material developments, social market rules and the political routines (i.e. situations of human-nonhuman interactions) are related to each other in the governance of Garabi. The cross-references between the phases of initiation, planning and design, execution and construction were thereby used to highlight the posited complexity and non-linearity of processes of transnational electricity regulation.

## 7. Summary and conclusion

The closing chapter of this thesis is structured in three main parts. In the first part, I summarize the theoretical argument and reconsider how my work challenges the state-of-the-art approaches in the field of IR. In the second part, I reflect on how the elaborated theoretical perspective worked out in my empirical analyses and review the most important findings Lastly, I map out possibilities for further research.

### Summary of theoretical argument and academic contribution

In the existing IR literature about contemporary energy transitions very little research has been dedicated to gather further knowledge on how different areas as planning, financing and operating energy infrastructure, the management of technological innovation and renewable energy sources, the spurring of economic growth, energy security and integration etc. are intrinsically *mediated* by inanimate objects and how this affects the scope and the options for the political governance of electricity systems. This is because, to a large extent, contemporary analyses of energy transitions and transnational energy governance in the discipline of IR still rely on *anthropocentric* and *linear* perspectives with regard to how existing and future energy resources relate to future energy policy (Geller, et al. 2004, Bahgat 2006, Goldthau and Witte 2009). In other words, these approaches regard technical objects such as renewable utilities, fossil resources or electricity grids as mere *instrumental facilitators* (Goldthau and Witte 2010) of energy transitions (Smil 2010) and public life, and not Latourian actors in their own right.

To recapitulate briefly the state of the discussion in IR I have introduced three bodies of literature in chapter two. In this context, I have first explained how *International Regime approaches* focus their attention on the processes of emergence and impact creation of international regimes between unitary *nation-states* while social and technical issues are treated as being *exogenous* to these political processes (Ruggie 1972, 1975, Krasner 1976, 1983, Keohane 1984, Haggard and Simmons 1987, Keohane 1989). I have credited regime theorists for acknowledging that there is a difference between the notion of 'territory', understood as demarcated political-administrative boundaries, and the notion of 'territoriality', understood as the possibility that issues that are of concern to political communities may be situated at the intersections of different political-administrative boundaries. But I have also criticized the fact that, in the end, these scholars continue to rely on a conceptualization of transboundary issues and transnational actors that does

not properly address the *constitutive* role they play in processes of political decision-making among states.

In a next step, I have therefore introduced contributions on the International Political Economy written by Susan Strange (1976a, 1976b, 1982, 1991, 1994a) (Stopford and Strange 1991) to highlight how traditional concepts of IR such as state power, the relation between the state and the international system, rationality and linearity, as well as technology and the question of conflicting interests may be challenged and re-conceptualized. My aim was to find tools that show how state regulation cannot be regarded as impacting on social and technical reality from the outside but needs to be understood as intrinsically intertwined with it. In this second main section of chapter two I have argued that Strange has contributed to the appreciation that the confinement of international *political* analysis to state actors alone is overly reductive (1982, 491). Specifically, I have pointed to her argument that such confinement does not address the state-society bargains that underlie international agreements among states. In this sense, I have argued that Strange was one of the first IR scholars to ask *who else* was involved in international political decision-making *beyond the state* and *how*. Her insight that the authority of the state is also substantially dependent on market development and technological innovation are of particular importance in the context of my research. It constitutes an attempt to conceptually relativize the tendency to static power allocation frequent in international relations studies. Most importantly, Strange contributes relevant groundwork to IR by criticizing the concept of resource-based *absolute* power advanced by realist scholars (Morgenthau 1948, Waltz 1979) and by coining the more differentiated notion of 'structural power' (Strange 1994a). By doing this, Strange advances the argument that it is not out of the will of an individual state actor but out of the *interplay* of these different sources of power that are embodied in the state, the market and technology, that "international" political structures and power realities are forged (1991). The concept of structural power relates to an actor's capacity to structure and control a *contextual environment* such as e.g. security, production, finance or knowledge (Strange 1994a) rather than his *individual* profit-maximizing *strategy* alone. Thanks to this more differentiated analytical apparatus she is then able to make the observation that rational choice theory gives an exceedingly idealized vision of political actors' purposefulness in decision-making processes. On the basis of the replacement of the traditional actor-centered perspective in IR by a social-constructivist perspective, Strange provides some initial scaffolding to the idea that means and ends are not always perfectly matched in a decision-making process. Rather they must be

understood as constructed in specific historical and political circumstances. Almost concomitantly, Strange then makes the significant point that the overtly static and formalistic theorizing as advanced by regime theorists also completely disregards the complexities of the empirical case itself. She advances that it is however exactly this empirical case in which agency is constructed by the interaction of agents and structures (Strange 1991, 4), and hence advises IR scholars - and specifically regime theorists - to switch from 'grand theory' models to more contingent models of theorizing that value the specific peculiarities of the individual empirical cases under study. By stimulating us to do so, she urges us to observe how much *effort* is actually put into achieving *durable* agreements on issues of contention between states and to appreciate that *change*, rather than stability, is the predominant modus of existence in the international system (Strange 1982, 488). However, despite praising[51] her appreciation that agents and structures are engaged in a mutually constitutive relationship as argued by Giddens (1984) and later by Wendt (1987), Strange's work lacks a sensitivity towards technical objects, their role *of their own* when it comes to understand the processes by which change in world politics is *mediated*. Indeed, even if Strange puts great emphasis on the role of technology in global politics (Strange 1991, 1994a) she does not examine how technology is just as well *constituted* in the interplay between "states and markets" (Strange 1994a) but characterizes it as a third external force capable to "redistribute power in favor of the rich and powerful and at the expense of the poor" (Strange 1991, 38) when it is not adequately translated into a competitive advantage by political and economic *human* decision-makers (anthropocentric perspective). In conclusion, Strange's re-conceptualization of notions of agency and power in IR reflect an important step in understanding how public policy and social life are linked to each other. But her conceptualization generates new setbacks and hence new problems in dealing with the question of how agency is constituted in world politics.

As a third contribution for investigating the complexities of world politics I have introduced Practice Theory. Practice theory is a theoretical approach that references an ethnographic study of *practices* as the smallest unit of analysis in IR. The main interest of practice theorists lies in displacing the notion of 'authoritative governance' away from closed unitary actors to everyday *situations* and *activities* of policy-making as this makes it possible to integrate a broader spectrum of agents (Adler 2005, Freeman, et al. 2011, Bueger 2011a). Practice theorists hence display a similar motivation as Susan Strange, that is, to shed light on the *dynamic* and *volatile*

[51] This is by comparison with the merely actor-centered perspective of International Regime Theory.

elements of political decision-making. Their use of practices as the smallest unit of analysis (Bueger 2011a, 11, 2011b, 1) provides useful in that it eludes the temptation of creating new setbacks between states, private and social actors without situating the custom of analytical boundary drawing in a concrete empirical case. Hence, it is within the scope of practice theory to determine the *coexistence* and the *overlaps* between distinct communities of practice that are regarded to shape governance patterns and arrangements (Adler and Greve 2009, 60). From the perspective of practice theorists, transnational governance arrangements are not established in a linear process of bureaucratic decision-making but *emerge* out of multiple and simultaneous interplays between actors pertaining to business, NGO's and states. By implication, transnational governance arrangements are conceived as "distinct *mixtures* of issue-based practices" between humans and things (Adler and Greve 2009, 59. emphasis added). This differentiation and hence the opening of the black box of the state (and by extension of other social groupings as well) proves consequential for IR theorizing because it provides a further step out of biased historic theorizing and territorialized thinking in the study of transnational energy governance. Nevertheless, the same caveat as for Strange applies with regard to the incorporation of material objects into the argumentative thread. That is the insufficient theorizing of technical objects as independent mediators of social and political realities. As IR is studied as a performative and intersubjective practice by practice theorists, governance is primarily affected by the *behavior* and *deliberation* of *human* agents (Buzan, et al. 1998, Adler and Pouliot 2011). Material objects may thus be facilitators of behavior and auxiliaries to discourses in this perspective but they do not affect behavior or discourse *intrinsically*. The "dark matter of society" (Latour 1992) remains yet to be unveiled.

As a consequence of the limitations of the reviewed IR contributions for the study of transnational energy governance, I have then explored the productivity of an object-oriented approach (Barry 2001, Latour and Weibel 2004, Latour 2005, Barry 2006, 2012, 2013, *forthcoming*) and reviewed relevant contributions from the field of Geography, Critical Infrastructures and the Built Environment which use this approach. Chapter three therefore develops my central argument on the organizing capacity of technical objects in transnational energy governance. On the basis of the contributions by Barry (2001, 2006, 2012, 2013, *forthcoming*), Aradau (2010), Bennett (2005, 2010), Braun and Whatmore (2009), Graham (2010a) and Graham and Marvin (2001) and others I have argued that human and nonhuman

actors *re-configurate* transnational energy governance and thereby *intrinsically* (and not social-constructivistically) co-produce it. They are reflexively *intertwined* with each other (c.f. e.g. Braun and Whatmore 2009, xxii).

Once again, the notion of the 'technological zone' used by Barry (2006) is useful here. A technological zone is a set of relations between human and nonhuman elements that are structured with reference to certain features of the social landscape such as electricity, pharmaceutics, telecommunication (Barry 2006, 241, 243). A technological zone emerges in the very attempt of reducing the differences between technical practices, procedures or forms. But this attempt must not necessarily entail a political governance dimension yet. With reference to transnational electricity systems, a technological zone is an assemblage of "highly specialized and localized linkages between producers, consumers, international traders, regulatory bodies and various intermediaries" (Barry 2006). In this assemblage the identity and role of each individual element are not naturally given but depend on the relations with all the other elements in the assemblage. In short, the technological zone emerges in the very *attempt* to harmonize and standardize technical discrepancies between different geographical territories or temporal intervals (Barry 2006). It is the result of considerable effort invested into making "measurement and quality assessment comparable" between different sites (Barry 2006, 240-241). This is why a technical electricity infrastructure as for example an electric transformer station between two countries such as Argentina and Brazil *may become* a central element of transnational electricity governance. In such a situation the electric transformer station is no longer simply a material object but an *informational material* (Bensaude-Vincent and Stengers 1996, Lash 2002, cited in Barry 2006, 242). It acquires agential capacity because it interacts with two heterogenoeus assemblages that are regulated in two distinct frequencies (Argentina 50Hz, Brazil 60 Hz). In other words, the transformer station *participates* in the transnationalization of electricity by putting two distinct technological zones into relation with each other and by collapsing them in a larger technological zone. By making a difference between one sort of technological zone (the 50Hz or 60 Hz zone) and another one (the combined zone) it becomes a 'boundary object' in the sense of Star and Griesemer (1989, 393):

> "Boundary objects are objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. They may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is key in developing and maintaining coherence across intersecting social worlds."

Hence, the implication for transnational electricity *governance* is that material objects such as transformer stations, frequency cycles and the like need to be taken into account in processes of harmonization and standardization across borders because they contribute to the *emergence* and to the *direction* that such processes take (Latour 2005, 46, 71, Barry 2006, 241). As Barry states, what makes transnational governance problematic is that it must at all times "attend to the complexity of [its] conditions of emergence and subsequent evolution" (Barry 2006, 243). He cites the example of the European Commission which inevitably must deal with questions about how livestock is slaughtered or pollution is produced by car exhaust fumes when it wishes to regulate these issues authoritatively (Barry 2006, 243).

In other words, my argument in this chapter turned on the necessity to give evidence to the fact that electricity infrastructure is not just a technical infrastructure supporting the everyday life of humans but has a central *organizing effect* of modern societies (Barry 2001, 22, Beck 2007). To support this argument, I have explained how technical infrastructure *participates in the enactment of* particular social constructs as identities, cultural values, ways of life etc. (Mol 1999, Aradau 2010, 2) and highlighted how it is by its *mediation* that *specific* social constructs– that is in their specific *form and contents* – are able to emerge at all. Taking into account that "technology plays a formative part in making up what we are as humans" (Barry 2001, 8) and vice-versa I have argued that it is more productive to conceptualize it as an assemblage comprising "forms of knowledge, skills, diagrams, charts, calculations and energy which makes its use possible" (Barry 2001, 9) instead of attempting to artificially distinguish it from social and political collectives as e.g. Strange (1994a) does. In this context, I have argued how the inclusion of nonhumans in political theory forces one to *re-consider* the significance of "public discussion, choice and politics"(MacKenzie and Wajcman 1999, 5) for the specific materialization of technical infrastructure and associated governance arrangements. By drawing on the example of metallurgy stated by Barry (2010, 91) I have elucidated how nonhumans may intervene directly in the

settlement of public controversy by generating their own effects in relation to the specific case of controversy. I have also highlighted that, however, nonhumans do *not* play a role *no matter what* the empirical situation is that we are looking at and that it depends on the specific empirical case at hand whether they are able to 'make a difference' (Latour 2005, 71) or not. The ultimate rationale of this argument is to demonstrate that technical infrastructure systems are ill-theorized when they are regarded as neutral objects of human deliberation: "Things are neither empty receptacles of discourses nor do they have essential characteristics that set them apart from humans. They are themselves agential and emerge in relation with material-discoursive practices" (Aradau 2010, 3). This argument matters because it helps IR scholars to conceptually and empirically demarcate those assemblages of humans and things that *specifically* play a role in the drafting of transnational governance arrangements in the realm of energy infrastructures. It makes a contribution to the discipline of IR in the sense that it propels an understanding of social collectives not as formal institutions or performative practices, but as a mixture of 'teamgeist' that embeds sustained performance (Van Wezemael 2008b) and the constraining and enabling characteristics of technical electricity infrastructure (Aradau 2010, Bennett 2010).

In the theoretical chapters on IR (chapter two) and on object-oriented politics (chapter three) I have presented two fundamentally different perspectives on the topic of transnational energy governance. In what followed, I thus regarded it as my main academic contribution to put the two bodies of literature into relation with each other and to produce a synthesis which would allow for the productive application of object-oriented politics to my empirical analysis of transnational electricity governance. The theoretical synthesis presented in chapter *four* has therefore synthetically discussed six main issues that affect the study of transnational electricity governance and evaluated the benefits and disadvantages of each of the theoretical contributions reviewed in chapters two and three. As a result of this discussion I formulated five theoretical questions that function as a specification of the research question formulated in the introduction. I situate the analytical value of these specified research questions in their opening up of traditional units of analysis of IR, both towards the inside (with regard to the social and technical components of state politics), and towards the outside (with regard to the embeddeddness of the state in a larger environment). They represent an unbiased analytical lens that sheds light on the traditionally hidden functions of electricity systems and their constitutiveness for all the processes of transformation that take place in society and politics (Kaika and Swyngedouw 2000, 120).

The usefulness of the theoretical synthesis that I elaborated in chapter four may be substantiated by revisiting the example of the technological unification of the electricity governance systems of Argentina and Brazil on the grounds of the individual state-of-the-art approaches that I have introduced. Taking the perspective of an object-oriented approach I have argued above that the transformer station converting electricity from 50 to 60 Hz and vice-versa between Argentina and Brazil constitutes an actor of its own in transnational electricity governance because it contributes to the *emergence* and to the *direction* that the process of transnational electricity governance takes in the region at hand (Latour 2005, 46, 71, Barry 2006, 241). The material object of the substation matters because it has a strong *structurating effect* in the agential assemblage of transnational electricity governance (Star and Griesemer 1989, 389, Barry 2006, 242). Without it the quality and direction of agency within this specific governance assemblage would be *different*. It is therefore constitutive for the definition of what standardization across state boundaries *means* in a contoured spatial and temporal setting of transnational decision-making (Star and Griesemer 1989, ibid., Barry 2006, ibid.). In short, it is the effort to deal with objects' technicality that gives rise to the very technological zone and thus to an informal or formal governance arrangement.

If we now consider this argument in comparison with a conceptualization of transnational governance as advanced by Strange a fundamental difference becomes visible with regard to the theoretical representation of empirical social collectives between the two approaches. Notwithstanding the fact that Strange lays several stimulating trails with regard to the dissection of traditional units of analysis in IR the inadequacy of her approach to agency is unveiled as soon as one tries to apply her differentiation of "three major sources of structural change" (i.e. states, markets, and technology, c.f. Strange 1991, 38 ff.) to the case of harmonizing connection standards between Argentina and Brazil. Indeed, and as I have also illustrated by means of the qualitative content analysis of eight major blackouts in chapter five, several heterogeneous elements need to be reassembled to make an electricity system work reliably. Most importantly, the working of an electricity system does not depend on the performance of each individual element but on the smooth *interplay* between all these elements. Strange sketches an argument in which the *interplay* between different "forces" (1991, ibid.) such as states, markets and technology is foregrounded vis-à-vis the performance of each individual force. What I am arguing however is that the distinction between these three "forces" becomes irrelevant and even 'disturbing' in that very moment when electricity systems enter the process of standardization.

This is because in this moment of a creation of a technological zone (Barry 2006, 240) these "forces" become *conflated* in one assemblage whose agency (its direction and dynamics) are not dependent on the "forces" (Strange 1991) or elements (Latour 2005, Barry 2006) themselves but on the "complex *linkages* between producers, consumers, international traders, regulatory bodies and various intermediaries" (Ong and Collier 2005, cited in Barry 2006).

Applied to the example of harmonizing interconnection standards between Argentina and Brazil this means that concepts such as "the state", "the market" or "technology" only acquire meaning *in relation* to other entities. "The state" is not a material entity that exists independently but it draws its significance from assembling a set of structured relations (in which it takes part) into a normative framework. The electricity "market" should be regarded as a set of relations that are structured with reference to customer supplier-relations, and "technology", in turn, as a set of relations that are structured with regard to particular *technical* devices, skills, and artifacts that support the performance of a particular task (Barry 2001, 7). Defined in this way it becomes clear that "states", "markets" and "technologies" can only be defined on the basis of the empirical case at hand and and are ill-suited as *a priori* structuring concepts for theoretical analysis.

A similar line of argument can be followed for a conceptualization of transnational governance as advanced by practice theorists (Adler and Pouliot 2011). Whereas the focus on everyday practices as the smallest unit of analysis (Bueger 2011a, 11, 2011b, 1) in transnational governance is an important stimulus in that it legitimately urges IR scholars to pay more attention to the commonplace particles that are constitutive to it, it fails to properly address the reflexive intertwinement of human agency with nonhuman material and immaterial artifacts). Returning once again to the example of the harmonization of connection standards between the Argentine and Brazilian electricity governance systems, I posit that praxeographists would advance that it is around the issue of electricity market internationalization that different elements of the "state", the "market" and of other "social actors" (Adler and Pouliot 2011, 4) converge. In doing this, I am arguing, their way of conceptualizing 'practices' as patterns of interaction between elements that can be categorized as 'statal', 'economic' or 'social' remains entangled in the social-constructivist 'trap' where *individual agents* in political theory are always representants of *a priori* existing social structures or groups (Latour 2005, 88). To translate this postulate to the process of harmonizing the interconnection between Argentina and Brazil means that practice theorists indeed accord significance to the *interactive* negotiation of standards between human agents as "meaningful behavior" in the context of transnational electricity governance systems

(Adler and Pouliot 2011, 6). However, their emphasis on the *meaningfulness* of agency puts the focus on human *intentionality* and perseveres in an anthropocentric allocation of roles in processes of transnational decision-making. By implication – because objects cannot voice meaning – this line of argument *subordinates* material artifacts to *strategies* of a priori defined relevant human actors. The picture that is sketched of transnational electricity governance of Argentina and Brazil is thus one in which individuals representing different intersubjectively sanctioned collectives, such as the government, the electricity company, the constructing firm, the affected population and others, decide on the appropriate harmonization and regulation of standards.

To summarize, praxeographists lend significance to *patterns of interaction*. However, the patterns of interaction they consider at all are strongly grounded in the assumption of *intentionality* of *human actors* while a technical artifact such as a transformer station represents merely an instrumental *tool* in the *purposeful* decision of relevant humans to integrate markets. This differs fundamentally from the perspective I am arguing with, which states that the establishment of a technological zone is an *emergent quality* of a situated agential assemblage that is structured with regard to particular features of the social landscape and that it can therefore not be determined a priori. In short, the decision to harmonize the connection between Argentina and Brazil should not be regarded merely as the will of pre-given authorities but should be investigated on the basis of object-oriented linkages that actually lend meaning to these authorities (or not).

**Productivity of the theoretical perspective for the empirical case and implications for IR**

After having specified my main research questions in the theoretical synthesis I have used data on eight major blackout events from the last decade to assess their relevance and to formulate first tentative answers on how human and nonhuman actors intertwine in the constitution of electricity governance systems. On the basis of the blackout analysis I have tried to make the functions of electricity systems more visible and to formulate answers regarding the multiple ways in which they are constitutive for all the processes of transformation that take place in society and politics (Kaika and Swyngedouw 2000, 120). The analysis of the blackout events disclosed that traditionally expected units of analysis of IR, as for example, state energy agencies, energy companies or technical engineers do possess relevance in the governance of electricity. However, the data also unveiled a series of noteworty shifts in the allocation of authoritative command over

the disrupted electricity systems, which can be considered as evidence for my argument that the identity and role of interacting elements is not naturally given but constitutes an emergent property of the assemblage under analysis.
Noteworthy shifts include:

- the re-organization of market relations across countries or across different regions of a country,
- the re-distribution of agency away from the state government and towards the responsible private sector owner in the case of a single utility failure,
- the re-distribution of agency away from the private sector owner and back to the state government in the case of a systemic failure with potentially harmful effects for the national economy,
- the foregrounding of a specific utility over another one or over a group of other utilities,
- the overlap and negative coincidence between geographically distant transmission lines,
- the divergent value assessments that transnational companies make of hydroelectricity under conditions of abundance and under conditions of drought, the necessity of integrated real-time information data over administratively separated geographical territories
- etc etc.

On the basis of these shifts it can be empirically shown how the relevance of an individual actor in an electricity system is not dependent on his position within a *pre-defined* 'relevant' social grouping but on the specific, that is, spatiotemporally circumscribed relations that he entertains with other elements present in the electricity system. As we have seen, in the case of a blackout, the relations between the elements present in an electricity system can shift in unpredictable directions. The disruption in one point of the electricity system acts in such a way as to swiftly assemble and concentrate particular sets of relations while disrupting and potentially excluding others. *Agency* in a blackout event, that is the convergence of heterogeneous elements towards the "out of order" of an electricity system, is thus to be regarded as *distributed* between those sets of human-nonhuman relations that *acquire* relevance *in relation* to the disrupted artifacts. Vice-versa it is to be regarded as *detracted* from those sets of human-nonhuman relations that *cease* to play a role in relation to the disrupted artifact. In short, the illustrations of relation reorganizations

presented in the chapter on the eight blackout cases (chapter five) have shown how the work of, for example, a transmission system operator in a transnational electricity blackout is dependent on the complex interrelations that exist between him, the technical devices at his disposal (real-time data management systems, type and number of power generation utilities, type and number of transmission corridors) and the existence and practices of other human agents in the systems. The kind of work he is able to do does not hinge (only) on his personal qualifications, then, but on the set of relations that exist in that area of the electricity landscape that he is trying to disentangle and, specifically, on his own relation with these elements (Barry 2006, 241, 243).

In short, *this* set of relations becomes *constitutive* for the kind of work he is able to accomplish. In situations where the electricity system is working properly, on the other hand, his work will hinge on *another* set of relations, namely those that prevail in the electricity grid at different locations and points in time (e.g. the volume of electricity traded at the intersection with another country, the economic activity of particular industrial producers, the volume of residential consumer demand etc.). Nevertheless, also in situations where the system is working properly, there is no "typical day" (Orr 1996, 14) in the work of a transmission system operator. Similarly to Orr's description of service work of technicians in the photocopier repair business, "some situations may occur more often than others, but on any given day anything may happen or nothing may happen, [rather] would some combination [or variations] of the scenes" described in the blackout events be characteristic for the type of work carried out by the transmission system operator (ibid.).

I have thus used my findings on the re-organization of relations in blackout events to formulate peculiar suppositions on how actors intertwine in the planning of the hydroelectric power plant of Garabi. This procedure of developing a fine-grained analytical apparatus in three steps – that is formal theoretical argument (chapter four), specification of questions and assumptions for the broad case of transnational electricity governance systems (chapter five), and lastly fine-tuning questions and assumptions by bringing them to bear on a specific case of infrastructure development (chapter six) – is consistent with my former assertion that the object-oriented approach of the sociology of associations appears rather as a method than as a theory proper from the perspective of traditional theory-building efforts – something that is both intended and welcome by its main authors (Callon 1986, Law 1986, Latour 1987, 2005). The application of the so specified questions and assumptions to the empirical case of Garabi has shown that the initiation and planning of the hydroelectric plant emerged out of a non-linear and iterative

process in which several elements and situations converged towards the enactment of this particular infrastructure project. By means of my presentation of the perspectives of several actors involved in the process I was able to pinpoint that the emergence of the hydroelectric power plant of Garabi on the political agenda cannot be attributed to the will of any one of the involved political decision-makers alone. Rather did it hinge on the *convergence* of particular elements and situations that *in their ensemble* participated in the *assembling of agency* in this particular infrastructure project. In chapter six I have thus used a series of extracts from the expert interviews I have held and constructed vignettes to provide a social model of how the multiple and overlapping material developments, social market rules and the political routines (i.e. situations of human-nonhuman interactions) are related to each other in the governance of Garabi. For the phase of initiation of the project I was able to show, amongst other situations:

- the centrality of the 1990s gas crisis in Argentina,
- the availability of technical and civil engineering expertise,
- the bond of regional diplomatic relations between Argentina and Brazil and the shifting prioritization of the project in relation to those situations.

Specifically the shifting priorization of the project in relation to the existing material conditions within a specific technological zone (electricity governance in Argentina vs. electricity governance in Brazil) provides useful to corroborate my argument that what instantiates and demarcates a political community in transnational energy governance is the formation of a contoured human-nonhuman assemblage around a specific technical artifact. As we can see from the analysis, the governance of the transnational governance system in the Southern Cone looked differently at the times when there was abundance and depletion of gas reserves in Argentina. In the former case, the governance arrangement emerged around the construction of cross-border pipelines and electricity substations towards Brazil and the direction of the market relationship was such that Argentina supplied Brazil with the energy. In the latter case, that is when Argentina experienced depletion of its gas reserves, the governance arrangement was forced to regroup around alternative material objects to preserve the transnationality of the electricity system. Given the situation of drought suffered by Brazil at that point in time, the conditions to engage in transnational hydroelectric cooperation were not immediately given for the two countries since Brazil was in the first place prompted to diversify its energy generation matrix away from hydro,

and towards alternative sources of energy production. After it had implemented important electricity rationing measures, reforms in the structure and infrastructural interconnections of its electricity market, and invested in the further exploration of gas and petroleum, however, Brazil soon gained more leeway to acquiesce to cooperate in the project of Garabi. If we compare the two cases of cooperation, we may observe that the technological zones that formed across the two political-administrative units of Argentina and Brazil at the time of cooperation over gas and over hydraulic energy had different spatial and temporal contours and therefore contributed to different figurations of transnational electricity governance arrangements.

Similarly, I have been able to show how the formal kickoff of the project led to a series of relational shifts as regards the organizational setup of the infrastructure project across the two political-administrative units: from the years of 2003 until the time of my fieldwork in the region a demanding series of taks was accomplished in the governance arrangement around Garabi, all centering around the question of who or what needed to be included in the carrying out of the project. The initial outline of the project team at the beginning of the planning and design phase highlights how individual entities such as individual human actors, environmental facts of the location of Garabi, and organizational routines within organized business companies needed to be re-configured across existing organizational divisions and infrastructures so as to fit the planning and construction task at hand. In practice, the modality of task and team expansion was thereby modulated by the continually emerging and shifting relations between the power plant and its environment and not by the political motivations of the involved authorities. It is in the nature of such a project that, at the beginning, only very rudimentary relations between the infrastructure and its surroundings could be postulated (that is, mainly, technical practices, competent individuals, and geographic and environmental scope). As time progressed, however, the project team could build on more and more in-depth knowledge on its project case and its dynamics. Thanks to this knowledge it was thus better able to particularize *who* or *what* the involved elements and adjoined additionnally relevant situations *were* and to *assess* how certain elements and relations would be *consequential* for the unfolding of the project. It is particularly with regard to the subsequent phase of execution that it becomes visible how the pondering of potential project-development-paths is dependent on specialized and localized knowledge that cannot be generated a priori but only in medias res (Latour 2005, 27, 123) - and only with significant *effort* to grasp the *concrete* connections to the task at hand. The extracts thus illustrated how knowledge from a wide range of different human and nonhuman actors had to be

iteratively combined and homogenized in order to give the project of Garabi its specific direction. Several assemblages (geographic location, volume of reservoir, installed potency, infrastructural interconnections etc.) matter for the future figuration of Garabi, and need to be mobilized and synthesized in one large assemblage in order for the planning and construction of Garabi to emerge. The set-up process of the project team, as well as the description of the ongoing interactions within it, reveal a highly nuanced spatial and temporal distribution of expertise across heterogeneous human and nonhuman actors. Specifically it reveals how an infrastructure project is never finished but constantly unfolding as a result of the multiple relationships in which it is embedded.

The implication for the study of transnational electricity and infrastructure governance from an IR perspective is that the traditional units of analysis and theoretical models of decision-making not longer bear resemblance to what is actually happening in the empirical field, thereby undermining the effectiveness of the actual governance arrangement. Coming back to the units of analysis postulated by Strange ("states", "markets" and "technologies") or Practice theory ("intersubjective practices") we must acknowledge, on the basis of the results of the two empirical analyses, that they generate new setbacks for the study of transnational electricity governance. This is because in the moment when a transnational governance arrangement, understood as a politically regulated technological zone (Barry 2006, 240), emerges, the distinction between these units of analysis becomes irrelevant and even disturbing. The "forces" postulated by Strange (1991) become conflated in one agential assemblage as well as the multiple "practices"(Adler and Pouliot 2011), which necessarily coexist and overlap in the field of transnational electricity governance. In both cases the direction and dynamic of transnational electricity governance is not dependent on the properties of these units of analysis themselves and neither on their potential interlinkages. Instead it is dependent on the particular way in which these interlinkages are *enacted* within the overall governance arrangement (Latour 2005, Barry 2006). There exist multiple ways in which the "complex *linkages* between producers, consumers, international traders, regulatory bodies and various intermediaries" can be enacted, and, by implication different governance systems may be up for discussion (Ong and Collier 2005, cited in Barry 2006). With regard to my introductory question about which electricity governance systems possess the best chances of successfully implementing a sustainable and reliable supply of energy the answer is thus: those who are best able "to attend to the complexity of their conditions of emergence" (Barry 2006, 243). In other words, relying on the traditional units of

analysis and theoretical models of decision-making of IR would be a mistake in that they do not allow us to contingently trace the elements and situations that are relevant for transnational electricity governance in different settings. By conceptualizing agency in transnational energy governance following a political logic of intentionality instead of one in which hybrid collectives account for the pace and direction of governance arrangements, the relevance of ideological drivers of energy sustainability might be overemphasized vis-à-vis its blunt materiality. As a consequence of this mismatch between the *theoretical* electricity governance *model* and the *effectively* involved actors, points in time, and geographic locations the effectiveness of the governance arrangement would be significantly undermined.

**Outlook**

The present thesis has aimed at making the complexity of transnational electricity governance systems visible and to point at the productivity of key concepts from the *sociology of associations* (Latour 1991, 1992, 2005) for understanding its evolution theoretically and empirically. With regard to further research on the topic I identify five promising directions for IR-related investigation. First, more effort could be invested to study *how traditional research questions of IR* could *inform* approaches from the field of Geography, Critical Infrastructures and the Built Enviroment in their endeavor to make the sociology of associations productive for the study of *political* relations in the field of transnational governance in general. In the present thesis, I have made a first attempt at walking the line between conventional IR scholarship and these so-called critical approaches towards transnational *energy* governance systems. I have particularly regarded it as my main academic contribution to put the two bodies of literature into relation with each other and to produce, by their synthesis, a more fine-grained analytical lense towards the reality of transnational energy governance. However, more fields of research remain open to investigation in IR in which alternative, but specialized, research questions and conceptualizations could help towards contributing to the *consolidation* of this materialist school in IR.

Secondly, and this direction for research is directly linked to the first one, empirical case studies on different types of infrastructures could come to support knowledge creation in the field of transnational governance systems. I am particularly thinking of additional fine-grained empirical analyses of different regions of the world, with different methods, and potentially a comparative

focus. The aim of this thesis was to provide initial scaffolding to this type of research endeavor by providing an *explorative* analysis of the governance of transnational electricity governance. However, more efforts to go in this direction is needed in order to further deepen and consolidate our understanding on the intricacies of human-nonhuman assemblages and their implications for transnational governance systems.

Thirdly, socio-scientific research endeavors could be undertaken with other analytical tools from the sociology of associations than the ones I am using here. The sociology of association as advanced by Latour (Latour 1991, 1992, 2005) provides a productive entry point for framing relevant research questions and dimensions. However, other terminologies and directions of conceptual research such as the one provided by *assemblage theory* (Deleuze and Guattari 1987, Deleuze 2006), *technicity and transductions* (MacKenzie 2001, 2002, 2010) or more *methodology-oriented developments of practice theory* (Bueger 2011b) could be useful in the analysis of IR, transnationality and transnational governance.

Fourth, I shall suggest that more research on the governance of transnational infrastructure systems could be carried out from the perspective of engineering sciences. The present thesis has tried to see behind the curtain of technological development and to provide limited insight on the topic as it is dealt with by technical engineers. However, the picture of transnational infrastructure that could be drawn by engineers themselves, under the employment of the critical vocabulary that I introduced here (chapter three) would most certainly allow for highly interesting discoveries with the potential to expand traditional notions of politics and of IR.

Lastly, I shall argue that as regards the study of energy by means of the sociology of associations there exists very little literature on transnational governance of the European Union and other industrialized regions as North America or Japan. The contributions by Barry (2001, 2005, 2006, 2009, 2010, 2012, 2013, *forthcoming*) constitute a solitary attempt in closing this research gap, but more such research remains yet to be done.

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TABLE 6: ARGENTINA BLACKOUT MAY 17TH 2007[1]

| | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q3 - What are the sources?** | **Q4 - Unfolding of movements of association between single entitites** | **Q5 - Reconfiguration? What is foregrounded? How does this become visible?** |
|---|---|---|---|---|---|---|---|
| | **nonhumans** | | **humans** | | | **groupings** | **what makes the reconfiguration visible** |
| **Argentina May 17th 2007** | fire (Ezeiza, Argentina);<br>one of three 800 MW transformers (Ezeiza, Argentina);<br>substation Garabi-2 (frontier of Argentina and Brazil);<br>transmission line;<br>air conditioning (households in La Matanza);<br>refrigerators (retail La Matanza). | Ezeiza;<br>Garabi;<br>La Matanza. | Julio De Vido<br>Argentine Minister of Planning and Public Investment (B.A.);<br>Spokespeson of National System Operator Brazil (ONS);<br>Silvio Resnich, CEO of Transner;<br>vendor at local shop. | Buenos Aires;<br>ONS offices, Brazil. | fire;<br>transformer station;<br>protection;<br>transmission lines. | Brazilian electricity grid (SIN);<br>Argentine-Brazilian subverter station;<br>suspect of malicious arson;<br>Edesur and Edenor and respective customers;<br>Spanish EPE interviewed De Vido and ONS speaker;<br>Argentine La Nacion published the news;<br>Transener Converter and Transmission Lines;<br>Food customers in La Matanza; | owner of Ezeiza transformers (Transener) and its CEO Silvio Resnich;<br>MINPLAN and its minister Julio de Vido;<br>Brasilian System Operator and its speaker;<br>Argentine-Brazilian trade relationship via SIN and Garabi;<br>Retail vendors as the speakers of the population;<br>Spanish news agency EPE, its correspondent, its readers;<br>La Nacion, Argentine newspaper publishing EPE news and its readers. |

[1] In each table the horizontal axis recalls the formulated preliminary questions (c.f. chapter four) and the vertical axis identifies the blackout under analysis. The tables are not to be considered as all-encompassing but provide a first entry-point into the transnational governance of electricity infrastructure.

TABLE 7: ARGENTINA BLACKOUT JANUARY 15TH 2008

| | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q3 - What are the sources?** | **Q4 - Unfolding of movements of association between single entitites** | **Q5 - Reconfiguration? What is foregrounded? How does this become visible?** |
|---|---|---|---|---|---|---|---|
| | **nonhumans** | | **humans** | | | **groupings** | **what makes the reconfiguration visible** |
| **Argentina Jan 1st 2008** | temperature above 30°C (Argentina & Córdoba);<br>pumping station transformer (Almafuerte, Argentina);<br>air conditioning (households Province of Córdoba);<br>high voltage transmission lines (Bahia Blanca);<br>daylight-saving times (Formosa, Mendoza, San Luis);<br>refrigerators at home and in stores (all affected localities);<br>traffic lights and gas stations (all affected localities);<br>elevators (all aff. localities) | Argentina;<br>Almafuerte;<br>Province of Córdoba;<br>Bahia Blanca;<br>Formosa;<br>Mendoza;<br>San Luis. | Adrian Calvo, speaker of EPEC (Córdoba, Argentina);<br>house tenents;<br>local journalists receive calls by affected people;<br>politicians.<br>Jorge San Miguel, speaker of provincial control organism in Córdoba). | punilla Valley;<br>sectors of Traslasierra;<br>several neighborhoods of Córdoba;<br>cities of the province of Córdoba: Río Cuarto, Alta Gracia, Carlos Paz, Cosquín y Río Tercero;<br>Bahia Blanca;<br>Formosa; San Luis; Mendoza | failure at pumping station;<br>protections;<br>disconnection of transformer from transmission and distribution lines;<br>Almafuerte transformer critical juncture between provincial distribution and national high voltage lines;<br>supply of province cut off;<br>high demand on hot weather day;<br>overcharging of high voltage lines; | punilla Valley;<br>sectors of Traslasierra;<br>several neighborhoods of Córdoba;<br>cities of the province of Córdoba: Río Cuarto, Alta Gracia, Carlos Paz, Cosquín y Río Tercero;<br>Bahia Blanca;<br>Formosa;<br>Mendoza;<br>San Luis. | selected customers in Córdoba province;<br>local distributor EPEC;<br>national transmissor Transener;<br>local media;<br>politicians that wish to drop out of daylight saving regulation to reduce the use of air conditioning in hot afternoons and summer evenings as well as electric lighting in morning hours. |

TABLE 8: BRAZIL BLACKOUT MARCH 11TH 1999

| | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q3 - What are the sources?** | **Q4 - Unfolding of movements of association between single entitites** | **Q5 - Reconfiguration? What is foregrounded? How does this become visible?** |
|---|---|---|---|---|---|---|---|
| | **nonhumans** | | **humans** | | | **groupings** | **what makes the reconfiguration visible** |
| **Brazil March 11th 1999** | problems in a transmission line in southern Brazi<br>hot temperature;<br>HEU;<br>lack of water and therefore generation;<br>lack of alternative power utilities;<br>gas-planning at very early stage and not finished;<br>concessions to industry to build 49 thermoelectric plants not concluded;<br>lack of investment funds;<br>autogenerators; | Brasilia Federal District;<br>16 states in southeast, center-east and northeast regions e.g. Parana, Rio Grande do Sul, Mato Grosso do Sul, Santa Catarina and the southern part of Minas Gerais;<br>cities of: San Pablo, Río de Janeiro, Minas Gerais, Salvador (de Bahía), Recife (Pernambuco), Porto Alegre (Río Grande del Sur) y Curitiba (Paraná). | Fernando Henrique Cardoso (Brasilia);<br>Wanderley dos Santos (UFRJ, Rio de Janeiro);<br>Sergio Abranches (political scientist, Radio CBN, different locations);<br>Aloizio Mercadante (vice-president workers party, );<br>Helge Karsten Reinelt, Speaker of Bayer Brasil (São Paulo;<br>Pedro Parente, speaker of the Management Board of the Electric Energy Crisis;<br>Rui Cesar Melo, Military Police Commander (São Paulo, Brazil);<br>Omar Assaf of the São Paulo Association of Supermarkets; (São Paulo)<br>Luiz Pinguelli Rosa, deputy director of the postgraduate engineering program at UFRJ (Rio de Janeiro); | Brasilia; Rio de Janeiro; São Paulo . | problems in a transmission line in southern Brazi<br>large drought;<br>weakness in the electricity grid working near full capacity;<br>empty reservoirs at HEUs;<br>mismanagement of energy production matrix;<br>lack of regulation;<br>missing alternative generation plants; | 13th National Economic Forum in Rio de Janeiro;<br>Presidential Elections;<br>Economic commentators;<br>hyperinflation; crime;<br>demand and supply;<br>rationing in southeast, northeast and centereast amay significantly endanger (international) industries and companies, fear of higher prices due to use of autogenerators;<br>mounting of (retrospectively) appropriate regulation and corresponding monitoring bodies;<br>hospitals, schools, official buildings, underground transport, households. | public life is altered by rationing (from 18h onwards): school children must retrun home immediately after class; no after-work drinks with colleagues; no late working in the office or on the computer without diesel generator;<br>restricted use of home devices;<br>purchase of buy a fluorescent bulb, flashlight, generator, gas-powered lantern, batteries or candles;<br>formation of different institutions as e.g. the Management Board for the Electric Energy Crisis;<br>change of habits: electrical device formerly seen as symbols of status and comfort in residences are now being regarded with alarm and disconnected from their sockets (Miriam Leitao, O Globo); |

TABLE 9: BRAZIL BLACKOUT NOVEMBER 10TH 2009

| | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q3 - What are the sources?** | **Q4 - Unfolding of movements of association between single entitites** | **Q5 - Reconfiguration? What is foregrounded? How does this become visible?** |
|---|---|---|---|---|---|---|---|
| | **nonhumans** | | **humans** | | | **groupings** | **what makes the reconfiguration visible** |
| **Brazil November 10th 2009** | storm;<br>high voltage transmission (Itaberá - Ivaiporã, Brasil);<br>HEU Itaipu (Itaipu, Brasil);<br>fissure of south-southeast power circuit in high, low, and medium voltage;<br>2 two-terminal devices of the HVDC system;<br>protections;<br>uncoupling of further transmission lines;<br>geographic distance between storm and transmission line (40km);<br>nuclear power plants Angra I and II (Iaorna Beach in Angra dos Reis, Rio State);<br>diesel genartors (Angra power station);<br>metro and transport in major economic hubs;<br>olympic and football cup sports and security infrastructure 2014/16; | Itaberá - Ivaiporã, Brasil;<br>Itaipu, Brasil;<br>States of São Paulo, Rio de Janeiro e Espírito Santo,<br>Northeast Region;<br>Minas Gerais, Goiás, Mato Grosso e Acre/Rondoni;<br>Itaorna Beach, Brazil. | Dilma Rousseff chief of cabinet;<br>Nivalde Castro and Roberto Brandao of the Study Group on the Electricity Sector (UFRJ, Rio de Janeiro);<br>Jorge Miguel Samek, Director of Itaipu HEU; Federico Bernal, Argentine researcher at CLICET;<br>Gabriel Argüello, public officer of CIER; Félix Herrero, consultant at Grupo Moreno Energia;<br>Hermes Chipp, ONS Speaker ;<br>Brazilian State President Inácio Lula da Silva; Pedro Figueiredo, head of operations at Angra NPU;<br>Edison Lobão, MME; José Sarney, president of the senate;<br>Paulo Bernardo, Ministry of Planning;<br>Antonio Otélo Cardoso, TEO Itaipu;<br>Chairman and vie-leader of DEM in senate; Agripino Maia RN party;<br>Professor José Antonio Jardini, Energy and Automation Department Poli USP; | Brasilia;<br>Rio de Janeiro, Brasil;<br>Itaipu, Brasil;<br>Buenos Aires, Argentina;<br>Montevideo, Uruguay; | technical fault in one of the single-current circuits of the Itaberá - Ivaiporã transmission lines;<br>possibly due bad weather conditions that led to overcharge in high voltage lines, then cut-offs of distribution system due to protecions;<br>overcharge of transmission lines also triggered disconnection of Itaipu due to protection mechanisms; | States of São Paulo, Rio de Janeiro e Espírito Santo,<br>Northeast Region;<br>Minas Gerais, Goiás, Mato Grosso e Acre/Rondoni<br>Itaipu HEU<br>Media;<br>Hydroelectricity matrix, reservoirs;<br>investments in transmission infrastructure;<br>Ministry of Mines and Energy, Brazil;<br>Meteorologists;<br>American news channel CBS;<br>suspicion of hacking;<br>ompanhia Energética de Brasília (CEB);<br>Río de Janeiro International Airport;<br>Furnas Electric Company<br>Monitoring Comittee for the energy sector (gov.);<br>Senate: Sarney Opposition;<br>presidential elections 2010)<br>political parties (DEM, PPS e PSDB) | Dilma Rousseff, becomes speaker of the government in regard of the blackout, because she had been the energy minister from 2003-2005<br>By comparison with the 1999 blackout the HEU and levels of reservoirs now take a back seat: they are on full capacity;<br>Consumer demand has already been stabilized via rationing in the aftermath of the 1999 blackout; nontheless it is adducted by president of the senate Sarney;<br>By contrast the question of investment in the grid and transmission lines gains prominence;<br>regional ties of Brazil are emphasized by Argentine and regional speakers;<br>blackout affected highly productive economic regions (São Paulo, Rio de Janeiro e Espírito Santo);<br>Large-scale blackout triggered hacking hypotheses;<br>Before the blackout CBS had used Brazilian blackouts of 2005 and 2007 to illustrate danger of hacker attacks on American energy system;<br>breakdown of transmission of Itaipu generation creates huge loss, approx. 1/4 of Brazilan energy concumption;<br>common people and journalists become source of information and provide conjectures, state lags behind with information; |

TABLE 10: UNITED STATES – CANADA BLACKOUT ON AUGUST 14TH 2003

| | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q3 - What are the sources?** | **Q4 - Unfolding of movements of association between single entitites** | **Q5 - Reconfiguration? What is foregrounded? How does this become visible?** |
|---|---|---|---|---|---|---|---|
| | **nonhumans** | | **humans** | | | **groupings** | **what makes the reconfiguration visible** |
| **USA-Canada August 14th 2003** | overload in power plant; lightning;<br>disbalance in Eastern Interconnection grid (Dayton Power and Light's Stuart-Atlanta lines);<br>tree growth;<br>real-time diagnostig support;<br>21 generation utilities, 9 of them nuclear; 7 of them closed down on purpose for protection (location unclear);<br>internet monitoring programs of the grid (electricity flow);<br>underground, lifts, broadcasting services;<br>airports;<br>security detectors;<br>auto generators;<br>automotive infrastructure (production in Cleveland and Detroit)<br>telephone system NOT affected but overload due to high frequency of calls; | Niagara Falls; Northeastern and Midwestern United States; and Ontario, Canada.<br>Cities of New York; Cleveland; Detroit, Toronto | Keitaro Matsuda, former economist at Union Bank of California (finance city, USA)<br>Bill Richardson, former minister of energy (Washington, USA);<br>Earnie Eves, Canadian Prime Minister Toronto, Canada)<br>Michael Bloomberg, maire of New York City (New York, USA);<br>George W. Bush (State president);<br>Peter Neumann, Infrastructure Monitoring Specialist<br>Dan Werton, Author of Book on Cyberterrorism;<br>Rebecca Lindland Director of Automotive Research Global Insight Financial Forecasting;<br>Luther Dow, director at the Electric Power Research Institute in Palo Alto, California;<br>Bill Lohrman, manager at the NERC (Washington);<br>Jerry Taylor, director of natural resource studies at Cato Institute (Washington). | California; Washington; Toronto, New York; Palo Alto; | rejection of investment plans in energy transmission by U.S. congress (national transmission grid study 2002);<br>US: overload in generator station;<br>Canada: lightning<br>lack of analyses, reports and assess-ments of voltage instabilities and long-term planning in the system on the side of within First Energy and ECAR;<br>failure at First energy to recognize the deteriorating condition of its system; tree growth;<br>lack of comm-unication between PJM and MISO Transmission Organizations;<br>getting the system running again after the trouble has been isolated isn't easy because the system has to be put back together one small piece at a time to avoid new power surges. | First Energy;<br>ECAR; memories of 9/11;cyberterrorism;<br>terrorist attack by Al Qaeda; Islamic Information Center reclaims authorship of blackout for Osama Bin Laden;<br>comparison with effects of a snow storm (natural hazard);<br>industry, finance, commerce of northeastern US and Canada;<br>Midwest Independent System Operator (MISO);<br>PJM Interconnection<br>American Society of Civil Engineers (ASCE);<br>Riptech Network Security Company;<br>CNN; FBI; police and fire department;<br>Brattle Group of Economic and Financial Experts;<br>Consulting Firms; Media;<br>elections november 2003 (Bush/Kerry); | Northeastern and Midwestern United States and Ontario, Canada form one integrated consumer market;<br>shift from administrative-energy to security affairs;<br>street vendors selling candles and bulbs at higher price;<br>transmission congestions on days of maximal capacity utilization, NYC and Long Island need to recur to autogenerators;<br>debate fluctuates between "bad infrastructure" and "high technology" infrastructure;<br>Economy: subsequent sales (flight tickets, food stocks, 5th Avenue Luxury Shopping) to compensate for losses;<br>people in New York City and across the region face waits for utility engineers to bring the systems back to normal service;<br>water, cooling, and autogenerators become most wanted goods and shift economic power relations; |

TABLE 11: EUROPE 2003A BLACKOUT BETWEEN DENMARK AND SWEDEN ON SEPTEMBER 23RD 2003

| | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q3 - What are the sources?** | **Q4 - Unfolding of movements of association between single entitites** | **Q5 - Reconfiguration? What is foregrounded? How does this become visible?** |
|---|---|---|---|---|---|---|---|
| | **nonhumans** | | **humans** | | | **groupings** | **what makes the reconfiguration visible** |
| **EU 2003a September 23rd2003** | airports; railservices; nuclear generation units out for maintenance (Sweden); trans-mission lines o. f. m. (between central and southern Sweden, Sweden and continental Europe, and Zealand and Germany; nuclear plant that shut down for problems (Sweden); generation reserves (Norway, Sweden and Finland); double busbar failure (West coast of Sweden); Four 400 KV transmission lines (central to southern Sweden, disconnection of nuclear unit from network); large power oscillations; low voltages; drop in system frequency; automatic under frequency load-shedding; disconnection of Denmark via protection devices. | Sweden, Norway, Finland, Denmark | Copenhagen Policeman Flemming Steen Munch asked schools and companies to motivate students and employees to stay longer to prevent traffic congestion | Copenhagen; | nuclear plant that shut down for problems creating an n-1 situation in the grid (Sweden); generation reserves (Norway, Sweden and Finland); double busbar failure created n-2 situation; multiple movements along the grid: (West coast of Sweden); Four 400 KV transmission lines (central to southern Sweden, disconnection of nuclear unit from network); large power oscillations; low voltages; drop in system frequency; automatic under frequency load-shedding; distance relays (central and Southern Sweeden) severed all remaining lines creating an electrical island (Southern Sweden and eastern Denmark); generation deficit led to collapse; disconnection of Denmark. | airports; railways; transport; police; Elkraft System; Svenska Kraftnät; IEA; | Denmark and Sweden go out of order together; an electrical island that formed included parts of Southern Seeden and eastern Denmark together; via the ordering of individual transport and behavior the police officer becomes the coordinator of public life;; the connection of the double busbar triggered an overload instead of reducing the current on the lines like it was expected by the technical engineers; |

TABLE 12: EUROPE 2003B BLACKOUT BETWEEN SWITZERLAND AND ITALY ON SEPTEMBER 28TH 2003

| | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q3 - What are the sources?** | **Q4 - Unfolding of movements of association between single entitites** | **Q5 - Reconfiguration? What is foregrounded? How does this become visible?** |
|---|---|---|---|---|---|---|---|
| | **nonhumans** | | **humans** | | | **groupings** | **what makes the reconfiguration visible** |
| **EU September 28th2003** | high load levels on Mettlen-Lavorgo 380 kV line (Switzerland); overheating of conductors; failure of Mettlen-Lavorgo line; Italian energy imports; high loads; trippin of Sils Soazza 380kV line tripped; tree flashover (Switzerland); transmission lines (Switzerland, Switzerland-Italy, Switzerland-France); Italian system desynchro-nized from UCTE network; protection devices; instability phenomena (Italy); generation shortage (Italy); failed automatic under-frequency plan of GRTN (Italy); primary frequency control; pumped storage power plants; industrial demand (Italy); Rendissone-Albertville trans. line load decline in UCTE system | Switzerland; Italy; France; | Karl Imhof, Director at ETRANS (Laufenberg); Luca dal Pozzo, speaker of GRTN; operator ETRANS (Laufenburg, CH); operator GRTN (Rome) forest ranger (region of Lucomagno, Ticino) Antonio Marzano, Italian Minister for Industry (Rome); André Merlin, director of RTE (France) Konstantin Staschus, director of German Association of systems operators (VDN, Germany); Johannes Altmeppen, director of Vattenfall Europe (VE, Germany); Joachim Vanzetta, Director of System Operations at RWE (Germany); Stephan Kohler, Director of the German Energy Ageny(Dena, Germany); Heiko Neus, Institute for Energy Economics, Univeristy of Cologne (Germany); | Germany, Belgium; Italy; Switzerland; France; | high load levels on Mettlen-Lavorgo 380 kV line (Switzerland); overheating of conductors; high trade between France and Italy; overloading of Sils-Soazza line; tree flashover; short-circuit; generation deficit in Italy; | UCTE; ETRANS; GRTN; Expert groups at transmission systems operators; Enel; Italian senate; disaster control committee; Sardinia; Eni; Atel; fact-finding-commission at Italian parliament; windproducers (especially in Germany); base load energy producers (especially in Italy, but also Germany); ACEA Italy; German Süddeutsche Zeitung postulates that blackout originated in Italy and spread to Switzerland;failure of 18'000 kV line in Region Charmilles-Vernier-Palexpo (Switzerland); Geneva police; Viasuisse | region covered by blackout; visibility of forestry activities; cut-out of Sardinia; debate on where the blackout originated (Italy or Switzerland); involvement of German windproducers in the discussion; successful blackout prevention reactions in Germany, France and Belgium; anti-blackout laws and investigative commissions established ex post in Italy; Italian Minister of Industry becoming speaker for the government; |

TABLE 13: EUROPE 2006 BLACKOUT IN GERMANY ON NOVEMBER 4TH 2003

| | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q1 - What are the (individual) entities involved?** | **Q2 - situatedness of entities?** | **Q3 - What are the sources?** | **Q4 - Unfolding of movements of association between single entitites** | **5 - econfiguration? hat is foregrounded? ow does this become visible?** |
|---|---|---|---|---|---|---|---|
| | **nonhumans** | | **humans** | | | **groupings** | **what makes the reconfiguration visible** |
| **EU November 4th 2006** | 380kV high voltage line crossing over Ems river (Weener, Niedersachsen, Germany); Norwegian Pearl cruise liner; re-scheduling; significant electricity flows from Germany to Netherlands and Poland (wind feed-in, Germany); 19 hrs communication lag between E.ON. And other TSOs; security analyses and calculations;; transmission lines; increase of load; switching measures; busbars coupling at transformer station; real-time databases; cold temperatures; heatings working all over Germany; Airport Cologne; Italian Grid; No high voltage lines between Germany and Belgium; | Niedersachsen; Papenburg; Ems river; Germany, Netherlands, Poland; | E.On Netz speaker and operators (Germany); shipyard representative (Germany); Achim Strauss, speaker of Deutsche Bahn (Germany); Speaker of french fire department; André Merlin, director of RTE France; Pierre Bonnard, speaker of RTE France; Speaker of Ministry of Energy (Duesseldorf); Speaker of Terna (Italy); Olaf Coermann, Wind producer in Schleswig-Holstein (Germany); Heinrich Brakelmann Electricity Expert at University of Duisburg-Essen; E.On Hanse speaker; Klaus Dieter Maubach, director at E.On; Michael Glos, German Minister of Economy; Konstantin Staschus, director of VDN (Germany); Philipp Strauss, Energy Researcher solar energy supply engineering institute in Kassel (Germany); Janez Potocnik, EU Research Commissioner; | Germany; France; Italy; | 380kV high voltage line crossing over Ems river (Weener, Niedersachsen, Germany); Norwegian Pearl cruise liner; re-scheduling; significant electricity flows from Germany to Netherlands and Poland (wind feed-in, Germany); 19 hrs communication lag between E.ON. And other TSOs; load increases; wind feed-in in Germany; | E.ON Netz; lack of access to real-time data; lack of coordination between TSOs; lack of joint simulation training; lack of coordination between operator's internal procedures; grid; markets; Austria, Belgium, Italy and Spain unconnected or succesfull prevention of blackouts; French EDF; Terna; German Energy Agency Dena; E.On Hanse; OPEC; Russia; nuclear and other production facilities; some sources state there was to little generation in the system (E.On. Netz); German Newspapers; German Political Parties; Population paying high energy prices; supply and demand mechanisms; | controversies around high or low loads on transmission lines; around importance of wind feed-in; around communication and coordination procedures; importance of a cruising ship in load scheduling; |

# Curriculum Vitae Jessica Crivelli

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Jessica Crivelli has been a political scientist and Ph.D. researcher at the Chair for International Studies of the Department of Political Science at the University of Zurich, Switzerland, since November 2008. Her research focuses on the politics of technology, especially on the governance of transnational energy markets. Her doctoral dissertation "WIRED POLITICS. Governing transnational electricity systems. The case of Argentina and Brazil" studies electricity governance through a comparative analysis of the major blackout events of the last 15 years and the detailed ethnographic case study on the governance of the Garabi hydroelectric power plant planned by the governments of Argentina and Brazil. In the final 18 months, her Ph.D. research project has been funded by the competitively awarded research grant CANDOC, conferred to her by the University of Zurich. To foster the further development and consolidation of critical approaches to the discipline of International Relations, she is also a member of the editorial and communications team of the journal International Political Sociology published on behalf of the ISA.

**Academic positions**

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| 09.2013 – 02.2014 | Senior Research Fellow at the University of Zurich, Center for Comparative and International Studies, Institute of Political Science, International Relations Department (Chair Prof. Dr. Stefanie Walter). |
| 11.2008 – 08.2013 | Teaching assistant and Ph.D. candidate at the University of Zurich, Center for Comparative and International Studies, Institute of Political Science, International Relations Department (Chair Prof. Dr. Dieter Ruloff). |
| 01.2012 – present | Member of the Editorial and Communications Team of the Journal International Political Sociology, published on behalf of the International Studies Association |
| 01.2011 – 08.2012 | Representative of the teaching staff ('Mittelbau') at the MACIS teaching committee, Center for Comparative and International Studies, University of Zurich and ETH Zurich, Switzerland. |
| 01.2010 – 10.2013 | Representative of the Chair for International Relations at the 'internal library council' of the Institute for Political Science, University of Zurich, Switzerland. |
| 01.2010 – 08.2010 | Project manager of the peer mentoring group PoliNet, Center for Comparative and International Studies, University of Zurich and ETH Zurich, Switzerland. |

**Previous education**

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|---|---|
| 10.2002 - 04.2008 | 'Lizentiat' (equivalent to M.A.) in Political Science, French Literature and French Linguistics at the University of Zurich, Zurich. |
| 08.1996 – 01.2001 | Maturität Type D at Kantonsschule Enge, Zürich. |